Index to Volume XXVIII

JANUARY TO JUNE

1912

The Journal of Electricity, Power and Gas

Published by the Technical Publishing Company
San Francisco, California

Index to Volume XXVIII

Illustrated articles are designated by an asterisk (*), editorial by dagger (†), and industrials by double dagger (‡).

Authors' Index

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JANUARY 6, 1912 | NUMBER 1

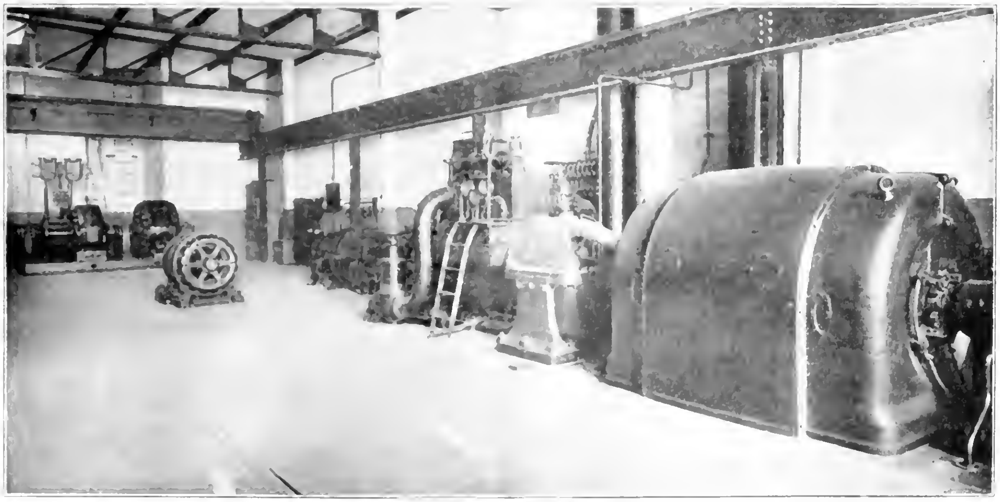
UNITED LIGHT AND POWER COMPANY

BY [illegible]

The United Light and Power Company is handling three combination steam and electric supply stations at San Francisco in such a unique and distinctive manner as to make the operating methods of great engineering interest. This company controls and operates the Consumers Light & Power Company, the Equitable Light & Power Company and the South-side Light & Power Company in San Francisco, as well as the Central Oakland Light & Power Company in Oakland, California. This article deals only with the San Francisco companies.

These companies are generating and distributing electric power at 220 and 110 volts, direct current; energy for lighting at 220/110 volts, two-phase, alternating current; and low pressure steam for building heating, water heating, and for kitchen use at from 1 to 6 lb. pressure. The three stations, as well as the distributing systems, both steam and electrical, are most intimately interconnected. The system of networks gives great flexibility and allows a [illegible] method of operation which will be developed after the several plants are described.

The generating plants of the companies are situated as follows: the Consumers Light & Power Company in the Whitney Building, the Equitable Light & Power Company in the Phelan Building and the South-side Light & Power Company in its own building adjacent to the Rialto Building, on Minna street. The Consumers plant is designed for direct current power generation only, the engines all exhausting into the



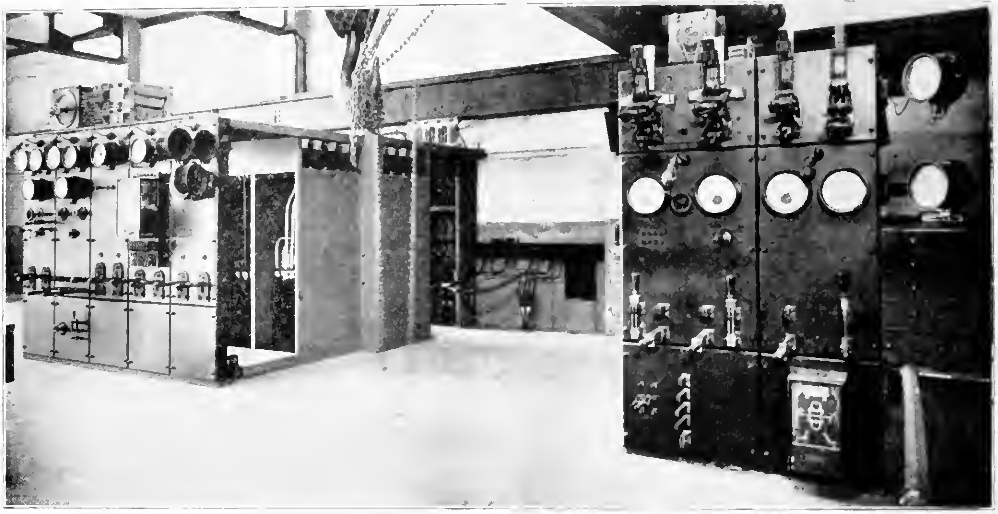
[illegible]

steam heating [illegible]. The other two plants are designed for [illegible] current generation and are equipped with condensers and cooling towers so that the [illegible] may exhaust either into the steam heating [illegible] or into the condensers.

Plant Equipment.

The Consumers plant consists of Franklin and Stirling water tube boilers, American ball angular compound reciprocating engines, and Westinghouse direct connected, 3 wire, direct current generators. The switchboard is of standard Westinghouse design.

The Equitable plant consists of Stirling water tube boilers, Westinghouse Parsons turbo generators and Westinghouse switchboard. There is, in this



Switchboard at Southside Plant.

plant, a synchronous motor-generator set by means of which the direct current power system and the alternating current lighting system are tied together. This set is a novel feature of the electric system of which more will be said later. The plant is equipped with a turbine exciter set and a motor driven exciter set, and is also arranged for excitation from the d.c. power bus bars when necessary. The cooling tower for the condenser circulating water is on the roof of the Phelan Building.

The Southside plant consists of the same types of apparatus as does the Equitable. The plant construction is different, however, the turbines and condensers being supported by the steel framework of the building so that they are directly over and close to the boilers. The cooling tower is on the roof of the Rialto Building. The motor generator here is an induction set.

Each of the above stations is equipped with fuel and water storage tanks and the usual fuel and feed water pumping sets. The plants in the Whitney and Phelan Buildings are equipped with ventilating fans to provide the necessary fresh air and keep the temperature normal.

Boilers at Southside Plant.

Electric Distribution System.

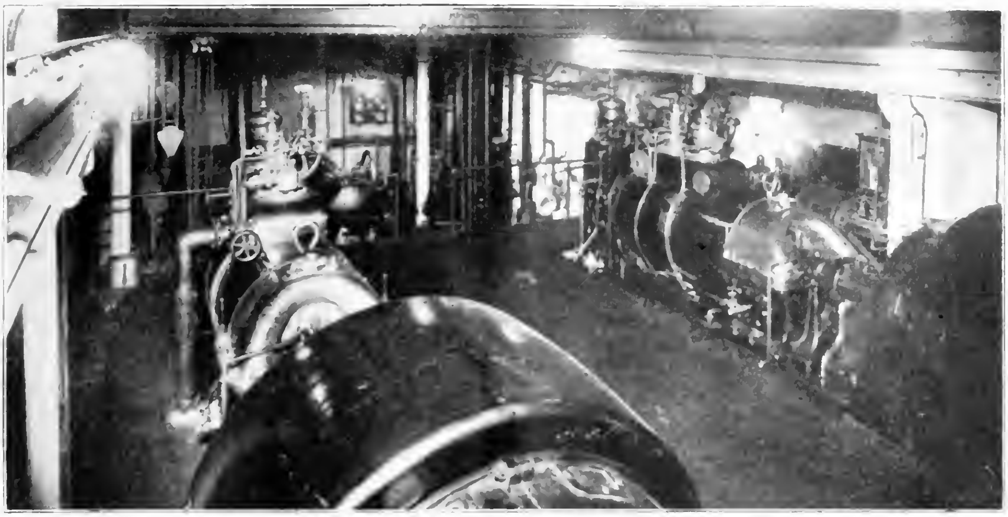
These three generating stations are electrically interconnected with suitable high tension and direct current cables so that the load may be carried by whatever units the engineers may choose to operate, or by the station upon which the steam system may be making heavy demands.

From each of the stations feeders radiate to the principal streets of the downtown business section. These feeders are frequently interconnected so that they form a very flexible and well balanced distribution system. The high tension system feeds standard Westinghouse manhole type transformers at 2400 volts. These transformers are banked together on the low tension side wherever possible.

The direct current feeders are run out from the Consumers station, and the motor generators of the other two stations are tied in directly with this station. Interconnection at various manholes, together with the above three sources of supply, further enhances the flexibility and balance.

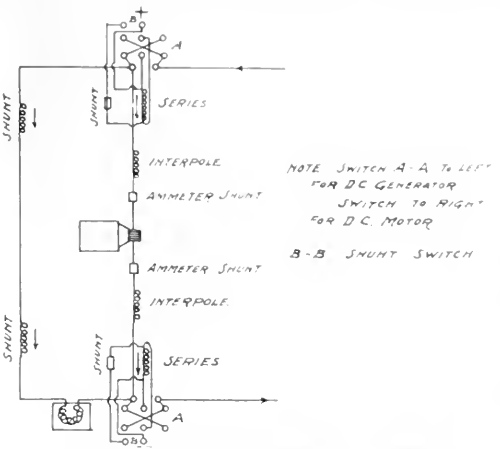
In addition to the flexibility existing in each of the above systems there is obtained a very interesting and useful combination of operation between the two systems through the synchronous motor generator set at the Equitable station. During the late night hours this set carries the power load alone, the Consumers station being shut down. During the peak hours in the early evening this set generates alternating current, operating in parallel with the turbines. This method of operation permits both the Consumers and the Equitable stations to carry full load on all units before it becomes necessary to call upon the Southside station for assistance. The labor expense is thereby reduced.

Considerable interest centered about the operation of this set in parallel with the turbines. It was at first found that, due to the poorer regulation of the



reciprocating engines in the Consumers station and to the fluctuation of the power demand, the motor generator, when generating alternating current, was inclined to take the load away from the turbines. This would result in opening the circuit breakers on the direct current side of the set, thus cutting the alternating current and direct current systems apart.

By the installation of double-throw switches, as shown in the accompanying diagram, the series fields

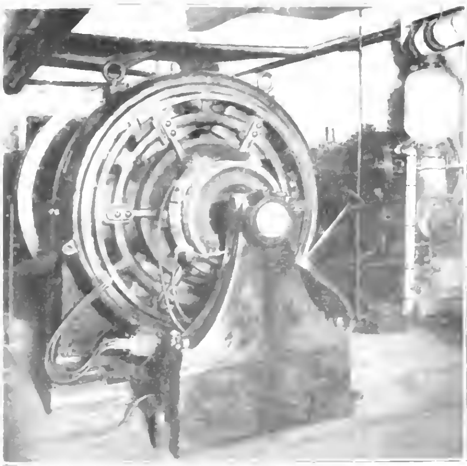


D. C. Converter of Synchronous Motor Generator

of the direct current motor were made reversible. When it is desired to operate the machine as an alternating current generator the double-pole double-throw switches shown at AA are thrown to the right. This makes a regular compound wound motor, the field flux of which increases with increased load. The counter electro-motive force of the motor increases correspondingly and this tends to decrease the speed and consequently reduces the load on the motor. In this way the motor generator set will carry its full load in parallel with the turbines and does not attempt to take more than its share. In fact, the variation in the alternating current meters on this set is no greater than the variation in the turbine meters.

When it is desired to operate the set as a direct current generator the double-throw switches are thrown to the left and the small shunt switch is closed, thereby giving sufficient compounding to enable the generator to share the direct current load equally with the engine driven generators at the Consumers station. In order that the polarity of neither the engine driven generators nor the motor driven generator be reversed, the proper amount of this compounding had to be very carefully determined as there were no equalizers between the two stations.

The existence of several stations combined with the resulting combinations of operation enables the companies to give a highly satisfactory service, the



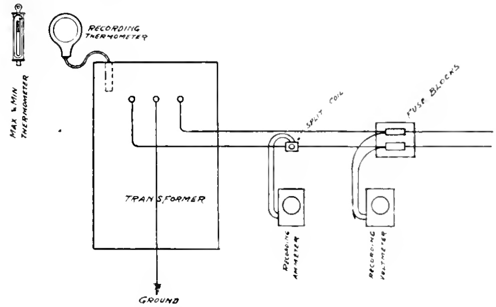
Plant

voltage regulation in the entire system being practically perfect.

The manhole transformers on the alternating current system are subject to considerable variation in load throughout the year. In order to know that they are not overloaded twenty-four hour tests are occasionally made with the apparatus as shown in the accompanying diagram. A recording ammeter and voltmeter determine the load on the transformer while a recording thermometer indicates the oil temperature and another the manhole temperature. Simultaneous readings of all necessary data are, therefore, had for any instant of the twenty-four hours, and a complete study of the transformer's behavior may be made.

Steam Distribution System.

The generating stations are interconnected with low pressure steam mains of the American District Steam Company's standard construction. These mains are largest at the stations, gradually diminishing in size as they approach the more remote districts. These lines are interconnected at various manholes so that a network of steam distribution in general paralleling the electric distribution system, enables the companies to serve buildings with both electricity and steam. The steam mains were laid in the same trenches with the electric ducts. A tin lined, wood casing surrounds the steam piping with a sufficient air gap to insure minimum radiation. Expansion and contraction is accommodated by devices known as variators. These variators are absolutely perfect in their operation, there having been no failures or leaks since the system was installed. Parts of the system have been in operation for a period of three years. During this time there have been no interruptions to service and practically no repairs have been made on the entire system.



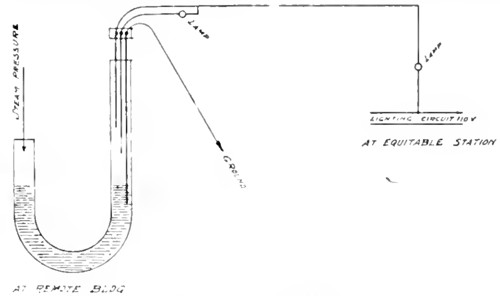
Transformer Recording Apparatus

As the steam demand varies with the temperature and weather conditions, it became necessary to know just what pressure to carry in the various stations so that the most remote buildings had sufficient steam. To accomplish this a steam pressure indicator was devised, as shown in the attached diagram. One small wire is used between the building at the terminal of the line and the Equitable station. The U-tube filled with mercury is placed at the building while the pilot lamp is situated at the Equitable station. Should the pressure fall below a predetermined amount, the middle terminal in the mercury tube will not make contact through the mercury to ground, and consequently the pilot lamp goes out. When the pressure is at the proper value the pilot lamp burns in series with a lamp at the building and thus gives about half candlepower. If, however, the pressure rises so that the mercury touches the upper terminal, the pilot lamp gives full candle power. The engineer has, therefore, to keep the pilot lamp burning dim in order to give all customers satisfactory service.

The operation of the steam distribution system is similar to that of the electric. As the load demand changes from the office buildings during the day to the hotels and apartment houses during the evening, it is supplied by the station which will give the most satisfactory service and fortunately this is usually the station upon which the heaviest electric demand is at the time being made.

Gate valves are installed at all intersections and are useful in regulating the pressure on various portions of the system; it being possible to increase or reduce the pressure on almost any line of the system at will.

Steam is supplied by the companies not only for heating radiation but for heating water, steam tables and the usual kitchen apparatus as well as for certain manufacturing processes. The companies install water heaters of their own manufacture and in such a way as to permit continuous circulation of the water through the heater, thus keeping it constantly hot.



Steam Pressure Indicator.

All services are trapped and the condensation from the buildings is metered. Data from the meter readings is of great value in improving the service to the building and regulating the system generally.

Steam Services to Buildings.

When the companies began connecting service pipes from their street mains to the existing buildings it was found necessary to run these pipes the entire depth of the building from the front to the rear. This was occasioned by the usual practice of locating the house heating plant, water heater and other machinery at the rear of the building. This location of the heater was probably found by the architects and builders to be more convenient for fuel delivery and usually more accessible for the house chimney. The kitchen of the hotel is also in the rear and the cook or handy man, janitor, or whoever acted as fireman was thus near the mechanical center of the building.

With the advent of central station steam this center of distribution for the building has become unsuitable. The cost of making the service connection is high. The presence of a long run of pipe supported

[illegible]

[illegible] Plant

from the basement ceiling is often [illegible] frequently radiates heat where it is not only unneces-sary, but sometimes undesirable. [illegible] the length of piping being considerable there is a corresponding loss of pressure when the [illegible] ing large quantities of steam.

In buildings erected since [illegible] steam supply, arrangements have been [illegible] agreeable to owner, contractor and central station, to terminate the building piping at the [illegible] wall. The foregoing objections are thereby overcome and usually an actual saving to the owner is made possible. It is felt that the value of this [illegible] be over-estimated by those interested in building construction.

In buildings equipped with high-pressure steam-driven machinery, the use of central station [illegible] pressure steam is easily made by adapting such machinery for electric drive. Steam hydraulic [illegible] equipment, for instance, can be served by [illegible] tion of a motor-driven centrifugal pump with automatic pressure control. The other utilities are even more easily substituted with electrically-driven machinery.

The Westbank Building is an apt example of [illegible] may be accomplished in this field. Here the hydraulic elevators, the air compressor, vacuum producer, kitchen fuel oil, and roof-tank pumps were all changed from steam to electric drive and the labor item completely eliminated, the fire risk diminished, and a very desirable day electric load created. The elevator motor and pump are of especial interest. A direct current interpole type motor is direct connected to a [illegible] Jackson three-stage centrifugal pump operating at 1700 r. p. m. The design of the pump is such that at 150 lb. hydraulic pressure it will have zero capacity, [illegible] supply [illegible] the water, while at 125 lb. [illegible] it will deliver full rated capacity, and at still [illegible] pressure a greatly increased output. It is thus [illegible] for hydraulic elevator supply since the cars [illegible] together, thereby demanding a sudden rush [illegible], but at reduced pressure. The motor control [illegible] the multiple unit switch field resistance type [illegible] by a master relay. The pressure regulation [illegible] by an air compressor type electric limit switch.

Steam Heating From Central Stations.

[illegible] of supplying the buildings of a large [illegible] from street mains fed by a central [illegible] station, or group of stations, is a compara-[illegible] one. The losses due to radiation and leak-age were formerly so enormous that the cost of such [illegible] became prohibitive. The recent development [illegible] American District Steam Company of their [illegible] of insulation and their expansion de-vices has not only made possible the supply of steam [illegible] from a central station, but this steam can be [illegible] at low pressure so that it may be taken [illegible] of engines and turbines, after [illegible] part of its energy for the generation [illegible]. It has thus become practicable to unite [illegible] important public utilities—electricity for [illegible] and power, with steam for heating and cook-ing purposes.

[illegible] technical dis-[illegible] that this combination [illegible] on, the writer has [illegible] for the purpose of [illegible]

[illegible] operation of this type [illegible] encouraging reports [illegible] in operation for a

longer period of time, insure that this is certain to be a permanent factor in the public utility life of San Francisco. It will be of interest to note some of the reasons for the rapid growth of the heating business.

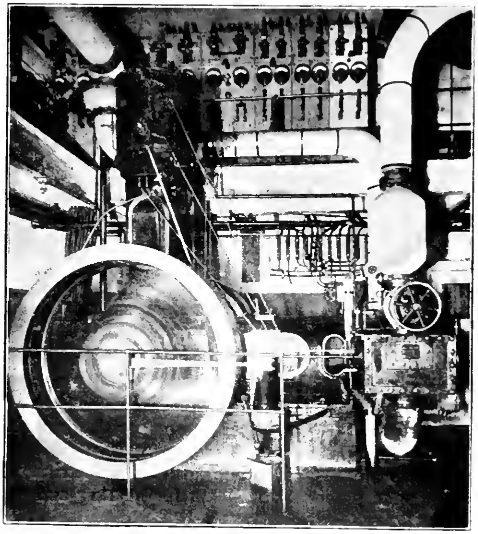
In ages past the public was accustomed to go over to the town pump for its water; to pour its own candles for light; and to go into the forests or mines and obtain its own wood or coal for heat. Then came the tank or cistern and the pump in the back kitchen; also the kerosene lamp; and the basement furnace, or steam boiler.

Later the water company was formed. It piped the building and provided the necessary pressure to insure a continuous supply of water wherever desired and without exertion other than the turning on of a faucet. Then came the gas and electric light companies locating their light at will and making it constantly available. Now comes the remaining utility —heat—in constant readiness at the mere turning of a radiator valve.

Just as the new methods of water and light supply have displaced the old, so is the new heat supply to banish the old. The reasons are obvious and sufficient.

The first cost of a building heating plant is from \$250 to several thousands of dollars according to the service to be given. This is entirely eliminated by the central station supply.

The labor of operation is avoided, and while this is usually combined with the janitor and house mechanic duties in one man, it is nevertheless an item of some moment. The recent passage of an ordinance by the San Francisco Board of Supervisors requiring



Angular Compound Unit and Switchboard at Consumers' Plant.

that any oil burning fire shall not be left without an attendant for a period greater than twenty minutes, adds increased importance to this labor consideration.

Then there is the fire risk. The entire absence of fire and fuel storage from buildings certainly materially lessens the danger from fire. While the Board of Fire Underwriters has not as yet seen fit to reduce the insurance rates in buildings heated from the street mains, it cannot fail to recognize this fact when the industry is older, more thoroughly investigated and better understood.

Other advantages as cleanliness, the absence of smoke from the numerous small chimneys, the uniform and continuous pressure of the steam supply day or night, and the demand service of an expert steam and heating engineer at all hours are best appreciated by those who have been obtaining the service for some time.

Regarding the cost of service and method of charging for steam heating; like the other utilities, water, gas and electricity, when first produced the steam service was contracted at a flat rate. This was based on the amount of radiation connected to the building piping. And, like the flat rate service of the other utilities, the steam flat rate charge is unsatisfactory and unjust to both consumer and central station, and more expensive to both.

By any method of basing it a flat rate charge per month or year cannot correctly remunerate a company for serving steam heat. If it is based on the radiation supplied, the charge then becomes a function of the architect's or heating contractor's ratio between square feet of radiation and cubical contents heated. This ratio varies from less than one hundred to more than one thousand, hence, a uniform charge per square foot of radiation may be ten times smaller or ten times larger than that of another building of similar size.

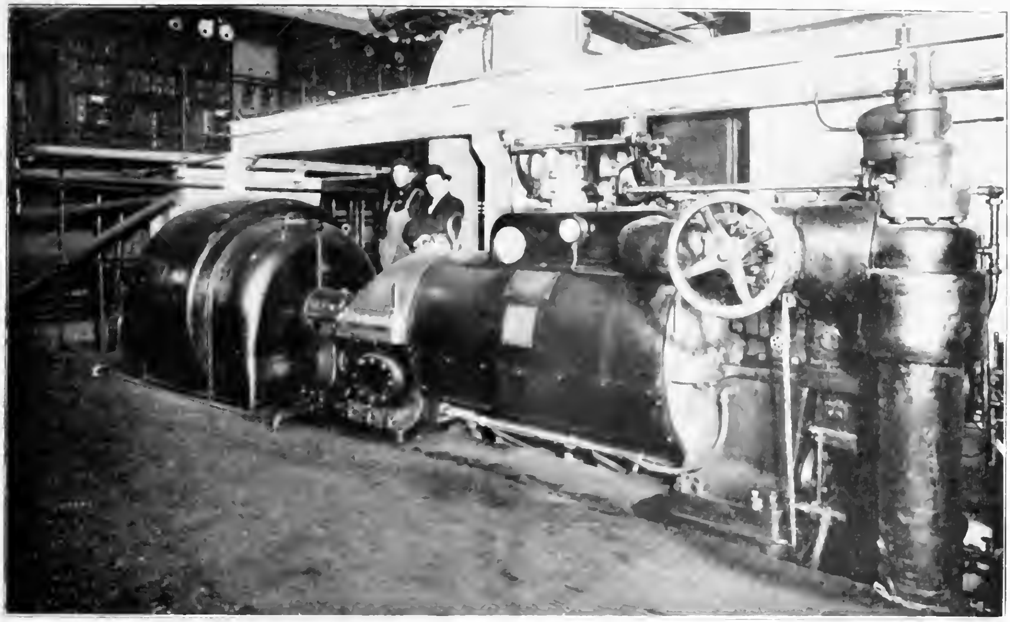
If the charge is based upon cubical contents the amount of radiation will again effect the result. If it is low the company will gain, if high, the consumer. And a hotel lobby constantly heated will pay no more than the upper floor of a furniture store which may be heated but once or twice a week.

These companies are, therefore, changing their method of charge to a meter basis. The condensed steam, or water of condensation, is weighed after passing through the building trap and before being thrown into the sewer. The meter used for this purpose is known as the simplex condensation meter. It accurately weighs and records the amount of water which has been condensed.

If, now, the charge for heating is based upon the number of thousands of pounds of water condensed, it is a direct payment for the heat used because a thousand pounds of steam at a given pressure always contains exactly the same amount of heat and a constant amount of this heat is given out when the steam condenses.

As with the other utilities with which comparisons have been made, there is an extravagant waste of steam when sold at a flat rate. From force of habit one will throw open the window when too warm, rather than turn off the steam and the radiators in unused rooms will be left going. Although entitled to all he may desire, the customer ultimately pays for this waste since no company can afford to serve steam heat at a loss. The extra fuel cost for this wasted steam is, of course, figured into the flat rate charge.

On the other hand, it has been found by those



Turbine and Switchboard, [illegible] Plant

companies which have changed their method of charging from a flat rate to a meter rate, that the consumption of steam in a building has been reduced often to one-half or less. Thus, while it may appear from the steam consumption, that if a customer were to pay the price demanded by the company per thousand pounds the bill would be double the existing flat rate bill, in reality it may be found that by a careful study of the steam consumption the bill by meter may be reduced to less than the flat rate bill.

These companies in bringing about the change to meter rates intend to send their experts among the various buildings to assist the customers in learning to economize their steam consumption.

The officers and engineers of these companies appreciate the fact that they are developing a new industry and they do not, therefore, profess to know or even predict what alterations and modifications of the service may be found to be advisable later. The public may be assured, however, that everything which experience proves to be possible will be done to give the most desirable service at the lowest cost consistent with conservative management.

GAS COALS.

With the idea of finding coals throughout the United States available for the manufacture of illuminating gas in order that they may be substituted for the higher priced and rapidly vanishing Pennsylvania gas coals, the Federal Bureau of Mines sometime ago completed a series of investigations which have just been embodied in a bulletin entitled "Coals Available For the Manufacture of Illuminating Gas."

"The annual drain on the gas-coal resources of this country and the importance of the gas and coke industries are indicated by the fact that 8,390,129 tons of coal were carbonized in retorts in the United States in 1909. The resulting salable products from by-product ovens were 15,791,220,000 cubic of coal gas, [illegible] tons of coke, and 60,126,000 gallons of tar. The total value of all by-product was $28,508,637.

"There are few well developed coal fields in this country that furnish coal satisfying all the requirements of illuminating gas manufacture. Most of the coal used hitherto has come from Western Pennsylvania, the quantity supplied by other fields being relatively small. The introduction of gas coals from new or little-known districts has been difficult because of the lack of necessary testing stations and of scientific study of the complex process of gas manufacture."

Detailed tests of the coals from various parts of the country are given in the bulletin, which may be obtained free of charge by applying to the Director of the Bureau of Mines, Washington, D. C.

ELECTROLYTIC RECOVERY OF ZINC.

A new process for the electrolytic recovery of zinc has been successfully worked out by Mr. Chitaro Yoshida, the proprietor of a copper mine in Iwashiro Province, Japan. The zinc ore is dissolved in the electrolyte, and from this liquid the zinc is precipitated by electrolysis. The process is simple, but several obstacles have been found. For instance, the presence of a small particle of copper, antimony, or arsenic is enough to render the process futile. One of the defects of the process heretofore has been the spongy form of the zinc which adhered to the cathode. To prevent this, carbon was tried instead of lead in the anode. The carbon was coarse and dissolved in the sulphate of zinc, and the zinc which gathered on the cathode was then found to be refined to a degree rarely possessed by the imported metal.

OTHER INDUSTRIAL APPLICATIONS OF OIL BURNING.

BY E. N. PERCY.

Lime and Cement.

Few engineers realize that nearly half of the fuel oil consumed is used for purposes other than the generation of steam; single cement companies taking as much as a thousand barrels a day and individual copper smelters more than this. Lime burning is now carried on with oil fuel exclusively where it is obtainable. Many different methods are used.

It has been found that when oil burners are applied to the ordinary kiln the outside is excessively heated while the center core of lime stone would be unburned. This is partly due to combustion taking place too close to the burner. It has been previously stated that the flame should not impinge upon anything, but this applied more particularly to boiler furnaces and a mental reservation was made as follows:

After atomization is thoroughly completed and the fuel has assumed a gaseous form and the admission of air is so distributed that the flame is long, soft, and slow burning without points of intense combustion, the flame may impinge upon and enter a white hot body of lump material having large interstices, such as lime stone, brick, etc.; but if the flame impinge upon such substances too close to the burner or before atomization is complete it will deposit carbon and oil and instead of entering the aggregate will be extinguished at the boundary lines. Therefore, in order to properly heat the center core of a lime kiln the admission of air should be distributed along the path of the flame so that it enters the aggregate after atomization is complete, but before combustion is complete. Good results can be obtained by the admission of stack gases into the furnace for the purpose of lengthening and softening the flame and so increasing the volume of hot gases that they must penetrate to the center core in order to find egress.

The upper part of Fig. 104 shows such an arrangement in which a steam siphon is used for abstracting stack gases; in the plan will be noted two slide gates, one communicating with the stack, the other with the atmosphere and connected with a common lever. A movement of this lever gives any desired mixture of air and stack gases. It might be mentioned that an actual economy is effected by this system because of a very high temperature of stack gases.

The lower part of Fig. 104 shows the arrangement of burner and draft tube used with such an installation, the effect being a wide conical flame through which the draft passes. It will be noted that where the stack gas system is used the mixture can be admitted near the burner, it not being necessary to distribute throughout the length of the flame. The amount of mixture, consequently the amount of oxygen, is regulated by the steam siphon and the quantity of the mixture is controlled with the slide gates.

Lime burning has been carried on in many other types of furnaces, and as the greatest success has been obtained, prior to the introduction of oil, with weak producer gases rather than direct fuel it is easy to see why the stack gas method would have such beneficial effects. Some lime burners have obtained the same effect with an extremely heavy fire and insufficient air and lots of smoke, but this takes more oil and invariably discolors the lime.

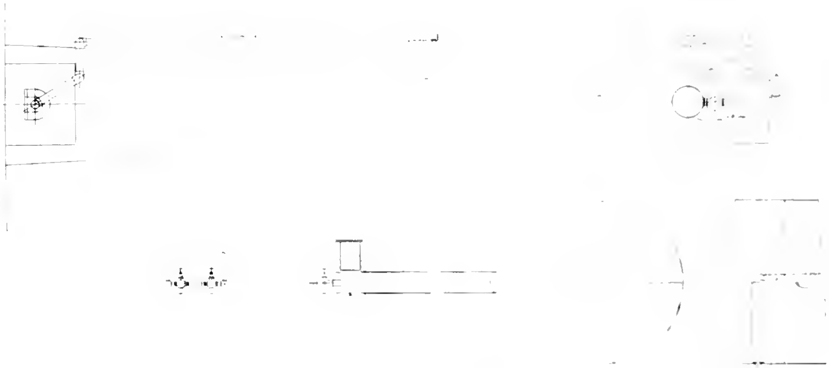


Fig. 104. Oil Burning S[illegible]

Cement furnaces have been highly conventionalized. They are invariably of the rotary type and the latest practice is divided as to length, some engineers using a kiln approximating 100 ft. and others as high as 270 ft. Two burners are used as a rule in connection with a low pressure air system.

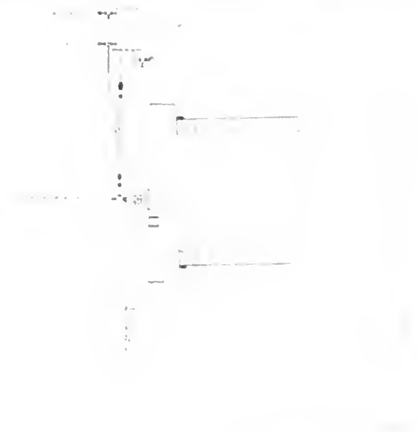
Fig. 105 illustrates such an installation around the furnace head. The furnace head is on a track partly to allow for expansion and partly so it may be readily wheeled out of the way for cleaning, etc. The air is used at about 2 lb. pressure. The oil pipes and heaters are overhead. The burners and shutters are of the type explained in the first part of this article, being swiveled so that they may be pointed to any part of the furnace; two are ordinarily used but are not located symmetrically as shown on the drawing, one being near the center of the furnace and the other on the side that is rotating upwards because the cement clinker lies on this side.

The economies that could be effected with oil fuel for cement burning are not nearly realized. The principal reason is that the product is immensely valuable as compared to the cost of the fuel. About one-

third of a barrel of oil is used in the manufacture of a barrel of cement. The value of the cement at the present market price is $2.40 per barrel as compared to approximately $0.20 for the oil used in making it.

However, great economies can be effected because, as has been determined on the best authority, about 396,260 B.t.u. per barrel is necessary for the manufacture of cement, whereas upwards of 2,000,000 B.t.u. is actually used. This can be bettered by depositing a clinker into a long draft tube through which all of the air for combustion is drawn, abstracting a large portion of the heat for the furnace. This is not done at present, the heat from the clinker coolers being wasted through tall chimneys that operate on the heat from the clinker.

The making of cement consists of [illegible] processes, first the [illegible]



which requires [illegible] ton or about 250,000 [illegible] process of clinkering [illegible] is about 100,000 [illegible] much heat, requires a [illegible] calcining requires a [illegible] Therefore, the front of [illegible] very intense combustion [illegible] getting along nicely with spent gases [illegible] As a matter of fact the flame [illegible] entire length of a hundred foot furnace [illegible] up the stack, but this is not all true [illegible] say incandescent carbon in process [illegible] but very largely red hot dust.

The great waste of fuel in cement burning is first to the failure to save the heat lost in the [illegible] secondly, the combustion is not kept sufficiently intense at the front of the furnace. The [illegible] should practically cease in the first 20 ft. of the furnace, the remainder being simply hot gases [illegible] flame. This can be accomplished with more perfect atomization, pre-heating of the air with clinker and highly heating the oil. The clinker rings which [illegible] in any rotary kiln are broken out by means of pokers 50 or 60 ft. in length, consisting of heavy pipe having a running stream of water which discharges into the furnace when in use. This [illegible] no trouble as the water is converted into steam [illegible]

[illegible] the smoke [illegible] the [illegible] all the [illegible] to [illegible] of the furnace [illegible] the ring tends to [illegible] the point of clinkering, although they can and do [illegible] at any point [illegible] fused clinker exists.

[illegible] action [illegible] are used to furnish the [illegible] for atomizing air for combustion, coming in by [illegible] partly through the same orifice through [illegible] the clinker discharges and partly through the [illegible] always existing in the head of the rotary kiln. The following data may be of interest [illegible] with this industry:

[illegible] per bbl. or 60 lb. per cu. ft.

[illegible] per bbl. or 95 lb. per cu. ft. loose, and [illegible]

[illegible] 2 cubic feet if packed. [illegible] cubic feet if loose. [illegible] cubic feet if shaken.

Brick.

[illegible] like lime and [illegible] of the most [illegible] are used [illegible] stacking of [illegible] described [illegible] those used for [illegible] and open, [illegible] kilns [illegible] operating alike, [illegible] of ware [illegible] with all kiln [illegible] better results [illegible] is remedied. It permits [illegible] burner. Kiln oper-

ators seem to particularly desire to have their burner lying on the ground or near it so that most of the air goes in over the burner and it smokes and deposits carbon continuously. In every case where the writer has raised the entire burner pipe and pointed the burner so that the flame shoots down toward the bottom of the oven in this way compelling all air to go through the flame, thus observing the principles previously laid down in this article, a marked economy has been effected. There is no necessity for operating a smoky burner on a kiln or elsewhere.

In one case a porcelain company was bothered with black and red specks in their ware. After a great deal of trouble and many analyses the writer established the fact that these specks were iron oxide and carbon. A study of conditions developed the fact that the iron oxide was due to the oxidizing of iron present in the clay under a high temperature with excess of air. The carbon was deposited from the burner. He raised the entire line of burners to the top of the oven openings instead of their usual position near the bottom and arranged the brick work so that absolutely no air could enter above the burner. Below the burner the air entered through a carefully constructed checker work, not the usual haphazard pile of bricks with one missing here and there for draft purposes. The product thereafter was satisfactory without specks of any kind. The consumption of oil was reduced over 20 per cent and the kiln did not smoke during any part of its run.

Fig. 106 illustrates such a kiln and it will be noted that the floor of the kiln is supported on piers and that the hot gases enter the chamber both through the wall bags and to the center orifice from between the piers

Fig. 107 illustrates some of the details of a correctly bricked up oven. It will be noted that this

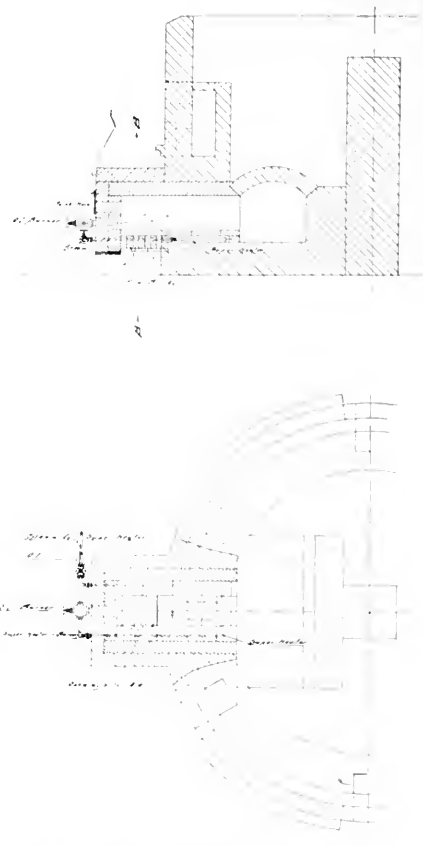


Fig. 107. Details of a Correctly Bricked Oven.

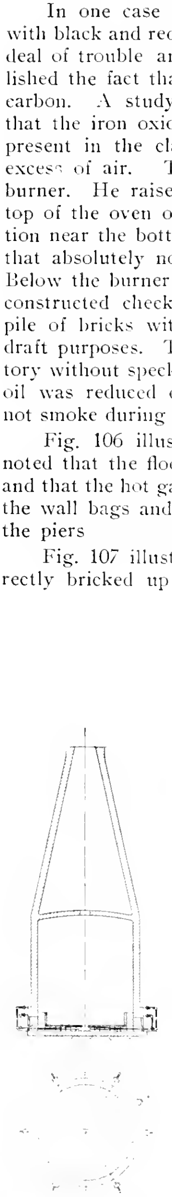


Fig. 106. Porcelain Kiln

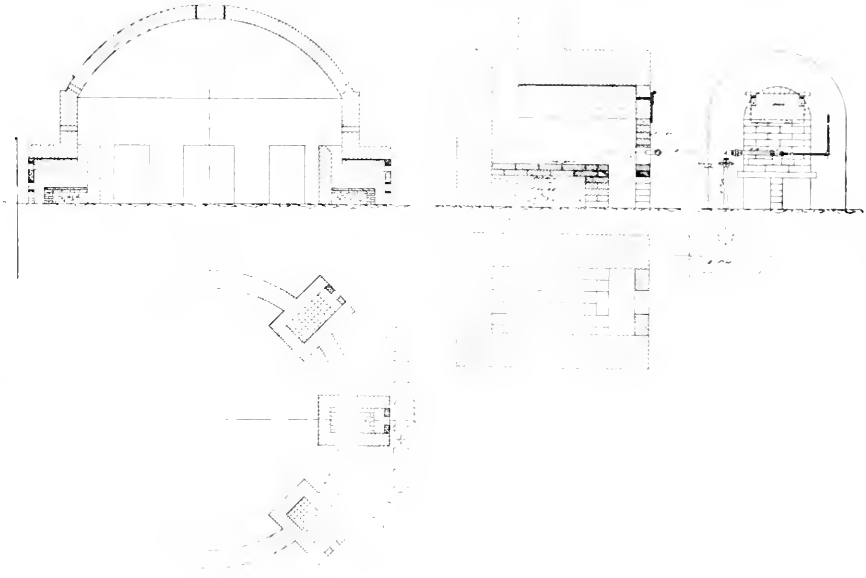


Fig. 108. Correct Kiln Bricking.

is very dangerous [illegible] done around a kiln, yet with [illegible] manner it is perfectly possible [illegible] beginning to end with absolutely [illegible] for perhaps ten minutes in the beginning [illegible] be noted that there is a heating coil [illegible] brick work. This is intended [illegible] steam only, and it should be pointed out that a great deal of trouble in kiln work results from the practice of not heating the oil. The importance of [illegible] the oil has been previously emphasized [illegible] cles and it should be stated here that [illegible] in the storage reservoir is not sufficient [illegible] oil. There should be a special steam [illegible] kiln to heat the oil just as it enters the [illegible] pipes for steam and hot oil should be [illegible] if the best results are obtained. These [illegible] are not unnecessary refinements because they [illegible] for themselves within a few months of [illegible] tion, and in some cases have paid for themselves completely with the first charge of the material.

Fig. 108 illustrates another arrangement [illegible] oven which is probably just as good since [illegible] principles are observed in connection with [illegible] might be noted that vitrified or terra cotta pipe [illegible] be used as air mains.

Smelting.

The smelting of copper, iron and other [illegible] with oil is a metallurgical specialty in each case [illegible] any of them will use the reverberatory or regenerative reverberatory for the purpose, oil not having [illegible] been applied successfully to direct cupolas [illegible] furnaces although there are several tilting furnaces [illegible]

[illegible] melting iron, brass. [illegible] elementary form [illegible] a fire brick oven [illegible] fired from [illegible] molten metal [illegible] and back [illegible] must be in [illegible] metal or [illegible] the temperature [illegible] economy [illegible] the stack [illegible] certain [illegible] waste gases [illegible] and the draft [illegible] chamber.

[illegible] of regenerative [illegible] going to [illegible] heated by oil [illegible] efficiently on

Fig. 110. Air Heater Arranged for Burning Fuel Oil

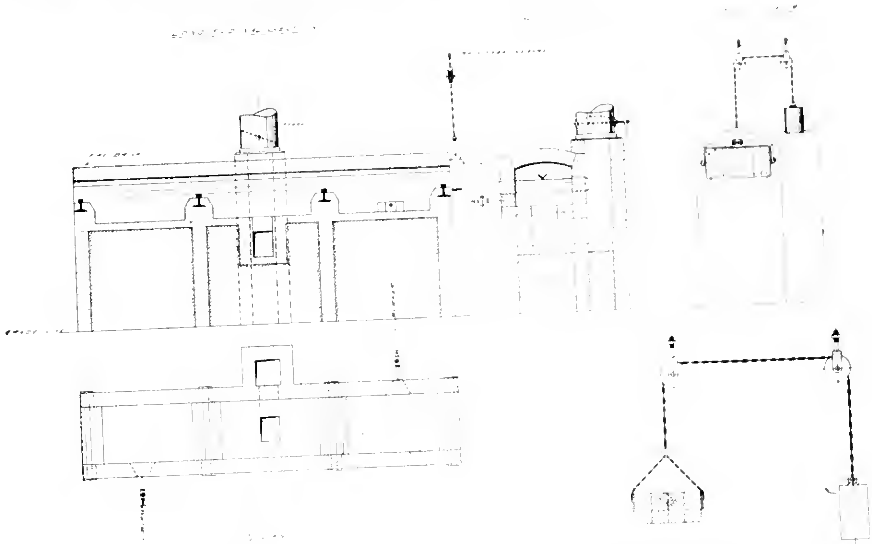


Fig. 111. Angle Iron Bending Furnace for Burning Fuel Oil

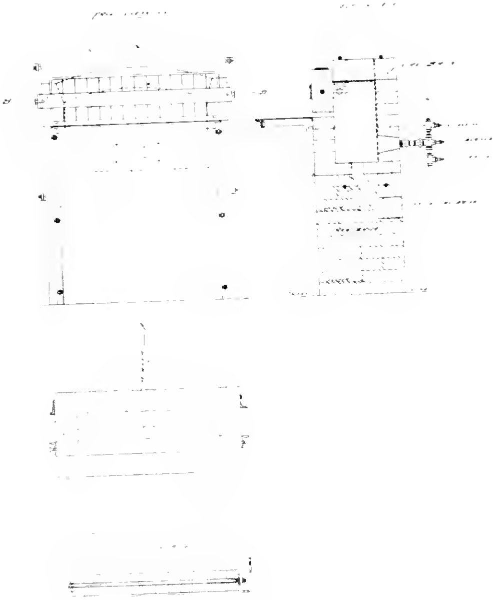


Fig. 112. Bolt Forge for Burning Fuel Oil.

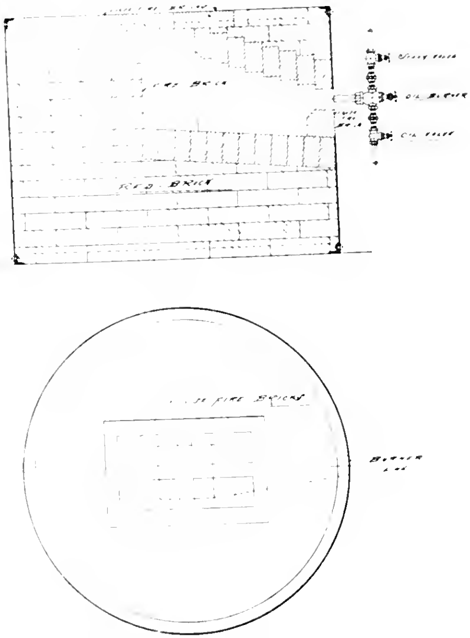


Fig. 113. Blacksmith Forge for Burning Fuel Oil.

account of the greater temperature range. Some reverberatory furnaces have all the burners at one end and put the material in at the other end, having thus a gradually increasing temperature and comparatively cool stack which results in a certain amount of economy, but this system is difficult to work practically.

Fig. 111 shows the arrangement of a furnace for heating structural iron, ship frames, etc., with fuel oil.

Fig 112 is an ordinary forge particularly adapted for bolt heating, and Fig. 113 is an ordinary blacksmith forge. Both of these have been used in actual practice with great success. The detail of the brick doors and covers should be noted as they are particularly difficult to construct on account of the brittleness of ordinary fire brick.

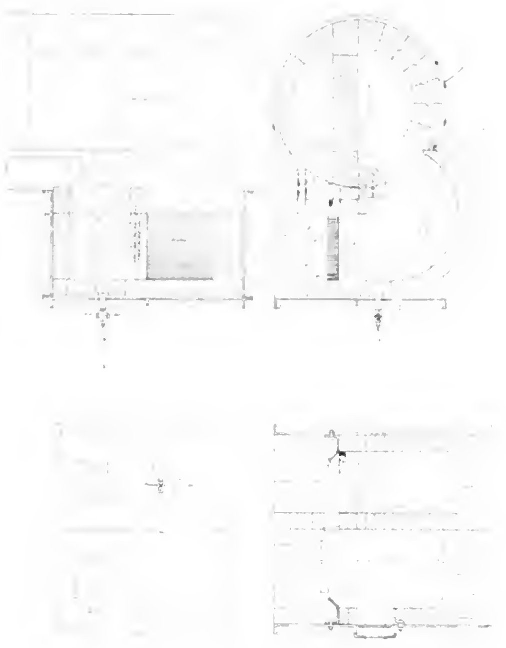


Fig. 114. Bar Furnace for Burning Coal and Oil.

Fig. 114 illustrates a bar furnace intended to burn either coal or oil or both together. This fuel condition being one that is often met in all classes of work. There are furnaces in actual operation today which burn three fuels, any two at once or any one alone.

Fire Brick.

In addressing this information to the practical man it is proper at this point to say something about fire brick. The most refractory material there is in the commercial world is pure lime, and a pure lime brick is practically invulnerable, but as it has no strength whatever a compromise known as the fire brick has been developed. A fire brick has two determining qualities, viz: strength and refractoriness. It is not possible to have an extremely strong brick that is also refractory, nor to have an extremely refractory brick that is very strong, and an engineer must make up his mind which he needs for a particular situation.

The chemistry of fire brick is entirely too complicated to go into here but certain elements may be touched upon. The best known foreign fire brick are found to consist principally of silica with one and a half per cent of lime for a binder and it will stand in the hottest part of a refractory furnace for four or five weeks at a temperature of 4000 to 4500 degrees. This implies simply when exposed to the action of the fire. If exposed to the action of molten ores, metals or slags, the abrasion then becomes chemical in character and must be called to the attention of the metallurgist.

Quoting from "Terra Cotta Topics": "Magnesite when calcined loses half its weight in carbonic acid gas. The dead burned material may then be ground and mixed with various binders, such as clay, anhydrous gas tar, magnesium acetate, magnesium chloride, carbonate of lime, oxide of iron, soda and either the silicate or oxide of iron. Bauxite, whose composition in alumina, 60 per cent; silica, 25 per cent; water, 15 per cent; and oxide of iron, is hard to be found constant and is seldom used, although very refractory."

The most infusible fire brick would consist exclusively of silica and alumina. Our good practical friend must not think that this is silicon and aluminum because it is not. It is a form of their oxides. It is not possible to find a material of this nature but the best fire clays are very high in these two constituents and the brick made from them are of excellent quality. The coarseness of the particles have much to do with the refractoriness of a fire brick. The more porous the brick is the more infusible it is.

Another important increment of the strength and refractoriness of the fire brick is the length of time it is seasoned before being burned. Fire brick should be laid in a minimum of mortar of their own composition. It should be remembered that fire clay does not cement except in the slightest degree, the intention with fire brick always being that they will fuse or glaze into a homogeneous surface, thereby obtaining such bond as they need, but the stability of fire brick structure should depend upon careful joints and proper construction rather than mortar. Ordinary fire brick such as can be procured at about $30 per thousand f.o.b. San Francisco will do for all ordinary work, but where they must receive the direct flame as in a forge, or be subject to tremendous radiation and flame as in a reverberatory furnace, there should be two courses of brick, one to withstand the flame and support themselves and another to assist in the structural support.

Those who wish to be a little more technical in their consideration of fire brick are referred to the work of Dr. Carl Bischof, a German chemist. He divides the clay into two parts: the silica and the alumina constituting the refractory part and the impurities the fluxing part. From these he derives a formula as follows, the summation of which is the index of refractoriness. Letting RO stand for the total impurities the formula will be as follows:

Al_2O_3 [illegible] SiO_2 [illegible] = Refractoriness

[illegible] Al_2O_3 [illegible]

[illegible] understand the acid and basic

action of brick in metallurgy. It is only necessary to remember that when metals or ores are molten they are just the same as laboratory re-agents and act as acids, bases, salts, etc., and will dissolve substances, crystallize and precipitate, and do all of the things that liquid re-agents do. In this manner certain molten materials will dissolve certain brick and have no effect upon others. Some of these materials for which brick must be carefully chosen are molten copper, iron, sulphur, porcelain, glass and lead. It has been stated that the user who needs an acid brick need not buy a basic brick but one who needs a basic brick must not buy an acid brick.

In connection with brick and its physical properties the reader is referred to articles written on the manufacture of oil gas by the writer for the Journal of Electricity, Power and Gas, of February 18, 1911. The manufacture of gas from petroleum is too wide a subject to take up in connection with this article, but interested readers are referred to the aforesaid article.

PRESENT STATUS OF LOS ANGELES AQUEDUCT.

A resume of the Los Angeles aqueduct construction up to December 1, 1911, and a prognosis of its finish are contained in a letter just sent by Gen. Adna R. Chaffee, executive head for the Board of Public Works and William Mulholland, chief engineer of the big project, to Kountze Bros. and A. B. Leach & Co., of New York, who head the syndicate that purchased all the aqueduct bonds to date.

The statement was prepared in answer to the following queries put by the syndicate and which evidently resulted from the alarming statements made by the Harriman party in the recent municipal campaign.

(1) Accidents to the aqueduct: cause, extent of injury, and probable and actual cost of repairs.

(2) Work done to date: cost, quality of construction and materials, amount of work remaining to be done, and estimate of time and cost for completing the same.

(3) Rights of city in respect to control and use of water to be supplied by the aqueduct, and concerning any controversies with the Federal authorities over water rights.

Accidents.

As might reasonably have been anticipated on construction stretching over a distance of 213 miles, there have been many accidents, though most of them have been comparatively unimportant. In only two instances have substantial failures of work occurred, and these were due to extremely difficult natural conditions, and not to defects in plan, workmanship or materials. In July, 1911, while constructing the concrete regulating gate in the aqueduct, just below the point of diversion from Owens River, the river reached a height unknown for more than thirty years before. By reason of the uncompleted condition of the work and the greenness of the cement just placed, the flood waters broke under and around the gate and ran down the canal for about five miles, where they were turned out and flowed back into the river. As soon as the flood subsided the gate was replaced, and additional construction in the way of sheet steel piling and concrete shut-off walls, suggested by the experience from the flood, was put in. The total amount of damage to the work hardly exceeded $1000; the additional construction mentioned cost about $3400.

The other failure of work referred to occurred at the point where the aqueduct crosses what is known as "Tehachapi Wash, about three miles north of the town of Mojave. A section of conduit about 1200 feet in length had been built across a delta composed of sand, gravel and boulders, which had been carried by flood waters from Tehachapi Canyon and deposited on the plain below. As afterwards appeared this material, though laid down by natural hydraulic process, had been left in an uncompacted condition, due to the rapid passage of the carrying agency. In the summer of 1910, after the construction of the section of conduit mentioned, a cloudburst occurred in Tehachapi Canyon, resulting in a flood of water which ran down over the delta to the aqueduct work, where its passage was obstructed by the dump made by the steam shovels on the lower side of the trench. This caused the water to back up over the work to a depth of several feet, where it stood long enough to thoroughly saturate the ground around the conduit, and thus caused a subsidence of the formation. The concrete was cracked and fractured by this disturbance to an extent rendering it necessary to replace the work in the section mentioned, and this was done at a cost of $27,000. The cost of this reconstruction was somewhat excessive, due to the hardness and superior quality of the concrete, which required heavy blasting for its removal, holes being drilled in the corners of every two foot square and shot with dynamite. The broken concrete was then run through rock crushers and used as broken stone for the making of the concrete for the new line.

Completed Work.

As to work done and to be done, cost, quality, etc. The amount of work done and to be done is shown by the following table, compiled as of December 1, 1911:

AQUEDUCT MILEAGE SCHEDULE.

Class—	Total mileage.	Completed 12-1-'11	Percentage of mileage accomplished.
Tunnel excavation	42.88	42.21	98.5
Tunnel lining	42.88	30.40	71.0
Colored conduit excavation	97.56	80.46	88.5
Covering conduit lining	97.56	78.44	80.3
Open conduit excavation	39.30	19.85	50.5
Open conduit lining	39.30	18.80	47.9
Unlined canal	21.30	20.92	98.3
Siphon excavation and piers	12.03	4.58	36.5
Siphon steel pipe	9.28	1.05	11.2
Siphon construction pipe	2.65	1.72	65.0
Flume excavation and piers	.17	.17	100.0
Flume waterway	.17	.17	100.0
Total excavation	213.24	167.99	78.9
Total lining	191.94	130.28	68.0

Cost of Work.

The cost of the work done, estimated total cost of each feature of the project, and the percentage in value of work accomplished, are shown by the following table, compiled as of December 1st, 1911:

EXPENDITURES AND PERCENTAGES

[illegible]	[illegible]	[illegible]	Percentage of class [illegible]
Tunnels	$ [illegible]	$ [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Siphons	[illegible]	[illegible]	[illegible]
Flumes	[illegible]	[illegible]	[illegible]
Reservoirs	[illegible]	[illegible]	[illegible]
Lands	[illegible]	[illegible]	[illegible]
All [illegible] power system [illegible]	[illegible]	[illegible]	[illegible]
Totals	$ [illegible]	$ [illegible]	

The percentage [illegible] [illegible] ber 1st, 1911.

[illegible]

[illegible] of $24,000,000 [illegible] cludes $25 [illegible] proximately $[illegible] work was [illegible] $24,500,000.

The [illegible] mates [illegible] changes [illegible] in preparation.

It should [illegible] that the [illegible] ing [illegible] [illegible] but owing to the [illegible] extent [illegible] work is [illegible] [illegible] until that time.

It is now estimated [illegible] struction of the aqueduct [illegible] early part of 1913.

The materials used [illegible] duct are [illegible] The [illegible] tured [illegible] [illegible] of Civil Engineers and the United States Army and Navy [illegible] tories at [illegible] strength [illegible] to the [illegible] which [illegible] taken as a standard Eastern cement.

Eleven miles of the aqueduct was let [illegible] [illegible] this has been finished: the rest of the work is being done by the city by force account.

Concerning the quality of the work done, while it is not pretended or claimed that in the 140 miles of concrete lining no cracks or pieces of poor concrete can be found, still, the extent of such defects is within a reasonable percentage, and the work as a whole is good, durable and satisfactory.

Sections of the aqueduct, as soon as completed, are thoroughly tested by erecting dams therein at intervals of three or four miles and filling with water, which is allowed to stand indefinitely. Frequent observations are made to determine seepage losses or defects in the work, and complete records are kept of these readings. In this way over forty miles of the aqueduct have been tested out, and found entirely satisfactory.

Water Rights.

The water rights of the city of Los Angeles in the [illegible] Valley were acquired by purchase from [illegible] and corporations, and by appropriation. [illegible] purchased are not affected by [illegible] in deed or law, in favor of the former owners. The city is authorized by its [illegible] general law of this State to provide [illegible] sufficient for its present and future needs. It is also authorized to provide for the temporary [illegible] supply, for irrigation, domestic [illegible] outside of the city. The question has been raised, particularly by parties opposed [illegible] project, as to whether the city, after [illegible] to furnish water for use outside of [illegible] the service. While the general [illegible] whenever the [illegible] its limits, the doubt [illegible] means that the city, in dis[illegible] will be particularly care[illegible] ordinances or res[illegible] its rights against any [illegible] the disposal of the [illegible] be limited largely [illegible] territory which by reason of rela[illegible] destined sooner or later to be [illegible] city.

The city of Los Angeles has [illegible] controversies [illegible] United States authorities in reference to any [illegible] rights. It has several applications pending for [illegible] for various purposes, but the [illegible] rights is not involved therein.

COMPUTATION OF HORSE POWER FOR RECIPROCATING ENGINES.

[illegible] the first case. We have [illegible] power of an engine is com[illegible]

$$H.P. = \frac{PLAN}{33000}$$

in which P is the mean effective pressure in pounds per sq. in. pressing against the piston head, L is the length of the stroke in ft., A is the net area of the piston head in sq. inches, N is the number of strokes per minute.

The particular problem then that we have in hand is to devise some method whereby we can compute without the means of an indicator card, the mean effective pressure or in other words the average pressure in pounds per sq. in. coming upon the piston head. In the expansion of steam after cut-off has taken place, the work that is accomplished during the remainder of the stroke is done by calling upon the reservoir of energy stored in the steam itself. Such an expansion in which no heat is given or no heat is taken away is called adiabatic expansion. In the case of a steam engine, however, where the steam enters a comparatively cool steel cylinder a certain amount of condensation takes place during the early portion of the stroke and evaporation during the latter portion of the stroke. It is found that the expansion in the steam cylinder under these conditions

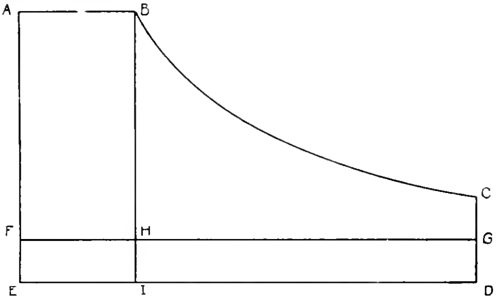


Fig. 41. Power Computation Case I.

corresponds more nearly to isothermal than to adiabatic expansion; that is, the temperature throughout the entire expansion practically remains constant. Assuming then that the expansion is isothermal we have for the entire work during one stroke of the engine cylinder the following:

$$\text{Work per stroke} = p_1 v_1 + p_1 v_1 \log_e \frac{v_2}{v_1}$$

in which p_1 is the initial pressure in pounds per sq. ft., v_1 is the initial volume of steam in cu. ft. and v_2 is the final volume of steam in cu. ft.

This easily can be seen by looking for a moment at Fig. 41 in which the line ED represents volumes to scale and the line E A represents pressures to scale. Let us lay off the boiler pressure and let the line E A represent to scale this pressure. Let us now assume that the piston head moves from A E to B. I. It is seen, then, that this expansion takes place under constant pressure and we have formerly seen that the work done by gas in expanding under constant pressure is computed by multiplying the pressure and the volume or in this case it is $p_1 v_1$. Again as the piston head moves from B I to K D the gas expands as we have seen, isothermally and consequently the pressure falls off along the line B C. We have previously seen that work in isothermal expansion is found by multiplying the pressure and the volume into the natural logarithm of the final volume divided by the initial volume, in other words, $\text{Work} = p_1 v_1 \log_e \frac{v_2}{v_1}$

Hence the total work performed in the entire stroke is the sum of these two separate quantities and we are at once enabled to write the equation hinted at above. Or

$$\text{Work per stroke} = p_1 v_1 + p_1 v_1 \log_e \frac{v_2}{v_1}$$

Since there are N of these strokes which take place per minute the total number of foot pounds of work accomplished per minute is

$$\text{FT. LB. of work per min.} = N p_1 v_1 (1 + \log_e \frac{v_2}{v_1})$$

Let us call the number of times the volume increases during expansion the ratio of expansion r and if l is the distance from the beginning of the stroke to the point at which cut-off takes place, v_1 is equal to l a, in which a is the piston area in sq. ft. and v_2 being the final volume after the stroke L has taken place becomes equal to L a, therefore $r = \frac{v_2}{v_1} = \frac{La}{la} = \frac{L}{l}$. Since now p_1 times a is equal to the total initial pressure in which p_1 is the initial pressure in pounds per sq. ft. and a the area in sq. ft. We also have, since P_1 is the initial pressure in pounds per sq. in. and A

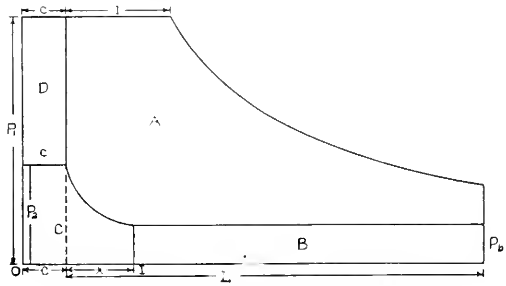


Fig. 42. Power Computation Clearance and Compression Considered.

the area in sq. inches, $p_1 v_1$ equal $P_1 A l$, hence we have that the horsepower in an engine cylinder can be computed by the formula.

$$H.P. = \frac{[P_1 l (1 + \log_e r) - L P_b] A N}{33000}.$$

since there are 33,000 ft. lb. per min. work in one horsepower. We have that the total horsepower is computed by the formula, since $r = \frac{L}{l}$.

$$H.P. = \left[P_1 \frac{(1 + \log_e r)}{r} - P_b \right] \frac{L A N}{33000}$$

In other words if we let the mean effective pressure $P = P_1 \frac{1 + \log_e r}{r} - P_b$, we come back to our original equation

$$H.P. = \frac{PLAN}{33000}$$

As an illustration let us take the following example: A simple steam engine is found to have the following constants: Boiler pressure 80 lb. gauge, point of cut-off is 6 in. from beginning of stroke, complete stroke 24 in., diameter of cylinder 18 in., revolutions per min. 120, exhaust back pressure 1.3 lb. gauge. What is the horsepower?

We have found above that the horsepower is expressed by the formula

$$H.P. = \frac{PLAN}{33000}$$

in which $P = [\frac{P_1 (1 + \log_e r)}{r} - P_b]$

By reference to our data we find that

$P_1 = 80 + 14.7 = 94.7 \quad P_b = 1.3 + 14.7 = 16$

$r = \frac{24}{6} = 4 \therefore \log_e r = 2.306 \log_{10} 4 = 1.3863$

$L = \frac{24}{2} = 2$ ft., $A = \frac{\pi d^2}{4} = .7854 \times 18^2 = 254.5$, $N = 2 \times 120 = 240$

Hence substituting, we have

$$P = \frac{P_1 (1 + \log_e r)}{r} - P_b$$

$$= \frac{94.7 (1 + 1.3863)}{4} - 16 = 56.55 - 16 = 40.55$$

$$\therefore H.P. = \frac{PLAN}{33000} = \frac{40.55 \times 2 \times 254.5 \times 240}{33000} = 150 \text{ Ans.}$$

Case 2. Referring now to Fig. 42 we are enabled to compute still more exactly the approximate h.p. of an engine by taking into account the clearance and also the compression. By referring to this figure it is seen that the net area which goes toward work is that indicated by A in the diagram. In order to compute this quantity A it is necessary for us first to compute E, the sum of the areas A, B, C, D and subtract from this sum the areas B, C and D. Looking now at Fig. 42 we see that the area of A, B, C, D is evidently

$$E = P_1 (l + c) + P_1 (l + c) \log_e \frac{L + c}{l + c}$$

$$= P_1 (l + c) [1 + \log_e \frac{L + c}{l + c}] \quad (1)$$

Let us assume the distance OI to be equal to x, in which c is the clearance and x the point of the stroke where compression takes place. Hence if we call P_b the back pressure on the cylinder when exhaust has taken place we have the area

$B = P_b (L - x) \quad (2)$

We also similarly find that the area C is equal to

$P_c c + P_c c \log_e \frac{x + c}{c}$, in which P_c is the pressure after compression has been completed in the cylinder. $P_c c + P_c c (\log_e \frac{x + c}{c}) = P_c c (1 + \log_e \frac{x + c}{c})$ and since the law of isothermal expansion we have that $P_c c = P_b (x + c)$. Hence substituting we have that the area of

$$C = P_b (x + c) (1 + \log_e \frac{x + c}{c}) \quad (3)$$

The area of D is $c (P_1 - P_c)$ or $P_1 c - P_c c$. But since $P_c c$ is equal to $P_b (x + c)$ we have that the area of

$D = P_1 c - P_b (x + c) \quad (4)$

If now taking the engine constants, we substitute carefully in these different formulas for A, B, C, D, we can at once compute their values and arrive at a very approximate computation for the work done at each stroke. In other words we can arrive again at a very approximate value for the mean effective pressure upon the piston head during the stroke.

To be clear in our method of procedure, let us go into details. In order to compute the horsepower of an engine by this more exact method, we must first measure up the constants necessary in the solution of the four equations derived above and then having computed E, B, C, D as shown in the four equations, we have, looking at Fig. 42, the area

$$A = E - (B + C + D)$$

This quantity A when thus properly computed is equivalent to the "PL" in the general equation.

$$H.P. = \frac{PLAN}{33000}$$

As an illustration of this second case involving the clearance in the engine cylinder and the steam left in the cylinder after compression begins, let us assume that the engine has the same characteristics as given in the first example, but in addition that the clearance is 1/10 of the stroke and that the point of compression is at 20 in. from the beginning of the return stroke.

From equations 1, 2, 3 and 4 above, we have

$$E = P_1 (l + c) [1 + \log_e \frac{L + c}{l + c}] \quad (1)$$

$$= 94.7 (\frac{6 + 2.4}{12}) [1 + \log_e \frac{24 + 2.4}{6 + 2.4}]$$

$$= 66.3 [1 + 1.145] = 142.5.$$

$$B = P_b (L - x) \quad (2)$$

$$= \frac{16 (24 - 4)}{12} = 26.65$$

$$C = P_b (x + c) [1 + \log_e \frac{x + c}{c}] \quad (3)$$

$$= \frac{16 (4 + 2.4)}{12} [1 + \log_e \frac{4 + 2.4}{2.4}]$$

$$= \frac{16 \times 6.4}{12} [1 + .9810] = 16.90$$

$$D = P_1 c - P_b (x + c) \quad (4)$$

$$= \frac{94.7 \times 2.4 - 16 \times (4 + 2.4)}{12}$$

$$= \frac{227.4 - 102.4}{12} = 10.41$$

$B + C + D = 26.65 + 16.90 + 10.41 = 53.96$

$A = 142.50 - 53.96 = 88.54$

Also

$$H.P. = \frac{PLAN}{33000}$$

Hence

$$H.P. = \frac{88.54 \times AN}{33000}$$

$$= \frac{88.54 \times .7854 \times 18^2 \times 2 \times 120}{33000} = 163.8$$

THERMOTWISTERS.

A simple non-condensing engine receives steam at ... and ... condenser with 24-in. vacuum ... cut-off at 1-5th stroke, the ... k. 95; the diameter of the ... horsepower?

... clearance of 1-9th stroke ... place 5-6th stroke on the ... formation compute more accurately ... installation.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to ooon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power aod Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

An Electrical Engineer's Prayer

The year returns and brings us the petty rounds of irritating concerns and duties. Help us, as we look into the bridal veil of mist shielding the blushing waterfalls so soon to be united forever with the stir and whir of man's industrial mechanisms, to feel that there is in Nature a silent yet resourceful supply of energy with which to overcome the cares and worries of our daily life.

When we follow with our eyes the noiseless transmission lines reflected in the stilly moon-lit night, may we ponder in our hearts how best we may put forth the same quiet yet forceful influence they exert for good among the affairs of men in the city a hundred miles away.

Let cheerfulness abound with industry, and as we watch the synchronous converter spinning out an even uniform current though propelled by positive and negative forces, may it imprint its lesson of harmony and industry deeply upon our thoughts and be of material assistance in our maintaining thorough synchronism with the affairs and inner life of our fellow men.

Give us to go about our business with industry and as often as we gaze into the recording dial of the watthour meter, may it, like the hour-glass of old, remind us of the passing of time with its opportunities, and as it measures off the energies put forth by the distant water-powers, may it remind us of the unseen watthour meter ever recording our energies and spur us on to higher and nobler acts.

May the low sob of the pulsating transformer entune our higher nature, and as the transformer secondary breathes and throbs with energies put into it by the pulsating primary, so may we of the sterner sex remember that largely the very life and heartbeats of family ties are nourished and strengthened by our energies; and in this conviction may we endeavor at all times to play the man.

And finally, each night may we come to our resting place weary and content, bearing in mind a picture of a day well spent, a day of passions governed with the same delicate mechanisms which control the energies of the power house of sufficient strength to turn the wheels of a city.

And now grant us—grant us now that we may close—may close our eyes in sleep. Amen.

Activities Ahead

Nineteen hundred and twelve ushers in an interesting panorama in the West. Montana, convinced of the wonderful lessening of mining costs by means of electric power operation, enters the new year with the brightest prospects ever seen before for hydroelectric operations in the great Treasure State.

Idaho, which has made such wonderful strides in scientific reclamation projects, enters the new year with even brighter prospects ahead. Development of cheap water power brings into the realm of possible reclamation millions of acres of lands, arid in nature, but soon to be an unlooked for pleasant asset to her natural wealth.

Washington, beset with numerous great decisions on water rights and railroad commissions, seems now to have passed the day of uneasiness, and enters a new

year with a better understanding of all parties concerned.

Oregon, with her ever increasing possibilities for hydro-electric development, is in a position to command the respect of the world for her promising agricultural possibilities and reclamation of vast acreages hitherto thought impossible of reclamation.

Nevada, hitherto hindered in its mining operations by inadequate supply of power, seems now to have in sight the early development of hydro-electric enterprises sufficient in their scope to rejuvenate this long lost empire.

Arizona, justly proud of its recent admission into the Union, enters the new year with electric power to operate her mining industry. Thousands of acres of land with waters already properly applied, and thousands upon thousands still waiting to [illegible] the industrious homeseeker of the future, [illegible] of her people steadfastly to the future.

California, with prospects ahead [illegible] international [illegible] through and through with [illegible]

The entire Coast [illegible] pletion of the greatest [illegible] inwardly pulsates [illegible] commerce of the world [illegible] outlook never [illegible]

If the New Year [illegible] strap-hanging friends [illegible]

The New Year For Electric Traction

[illegible] peace to the [illegible] and a happy [illegible] owners of [illegible]

If the New Year [illegible] road [illegible] Spokane [illegible] apples—

If the New Year [illegible] fied railroad system [illegible] metropolis—

If the New Year [illegible] of the Southern Pacific [illegible] and [illegible] tossy [illegible] and [illegible]

We [illegible] New Year [illegible] these [illegible] return to us [illegible]

We have [illegible] tive by [illegible]

Power Plant Education

Although [illegible] surrounded by [illegible]

energies which would naturally be devoted to digging [illegible] the laws governing the perfect operation of the power plant, are diverted into other channels.

A thousand times during the busy day even the most industrious operator has a minute here and a minute there which he could be profitably devoting to improving his general knowledge in affairs electrical. We are all of us by nature as lazy as we can be. With no encouragement on the part of his superiors, the young power plant operator takes the course of least resistance. The Police Gazette and Diamond Dick occupy the most conspicuous places [illegible] many of the operators' tables during the working hours.

The recent action of the officials of the Pacific [illegible] & Power Company in supplying wholesome technical literature to all of their numerous power [illegible] serves more than passing notice. The striking thing that impresses one in entering any of their [illegible] houses is the ambitious and orderly group of young operators being reared in their employ. Upon [illegible] table may be found three or four of the [illegible] best technical magazines published. No other [illegible] to be found.

The result is that the young man, often having [illegible] leisure in his working hours, uses it in [illegible] general knowledge concerning technical [illegible] is surprising how soon this encouragement [illegible] of the management shows itself in [illegible] efficiency of the entire power plant [illegible] otherwise surprising to see how rapidly [illegible] are enabled to advance over operators [illegible] power plant installations where this encouragement [illegible] the part of the managerial forces is lacking.

[illegible] yet deep felt influence will not be long [illegible] itself felt in decreasing the depreciation [illegible] the general wear and tear of the power [illegible] young man in need of the sincere fatherly [illegible] responds wonderfully with [illegible] his nature. Let us hope [illegible] managers will early see the [illegible]

[illegible] influence is keenly felt in every [illegible] Noah Webster uncon[illegible] truth when he wrote his dry [illegible] still further embellishing his [illegible] "To pop the question, so

[illegible] profession or every [illegible] his profession [illegible] worker [illegible] the [illegible] him [illegible] ahead for [illegible]

[illegible] up the ma[illegible] still further [illegible] human kindness and [illegible] first round of life's [illegible] gaze steadfastly

PERSONALS.

Ray D. Lillibridge, of New York City, is at San Francisco.

Thomas D. Petch, manager of the local lighting system at Medford, Ore., is at San Francisco.

J. C. English, who is a large dealer in lighting fixtures at Portland, is a San Francisco visitor.

Wynn Meredith, the Pacific Coast manager for Sanderson & Porter, is visiting the New York office of the firm.

W. T. Smith, manager of the Salt Lake City office of the Westinghouse Electric and Manufacturing Company, is at San Francisco.

H. L. Jackman manager of the Humboldt County interests of the Western States Gas & Electric Company, is at New York.

A. L. Searles, manager of the rock drill department of the Fort Wayne Electric Works, is at the San Francisco branch office on a tour of the Pacific Coast..

W. E. Barrett, gas engineer, with J. G. White & Company, of New York, is at Los Angeles, where he will spend some time in connection with new contract work.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, of Chicago, will spend the next two weeks on a tour of Southern California.

H. R. Noack, president of Pierson, Roeding & Co., is making a business trip through the Pacific Northwest in the interests of the firm's various electrical agencies.

E. V. D. Johnson, manager of the Northern California Power Company, has arrived at San Francisco, where his office will be located in future instead of at Redding, Cal.

Sidney Sprout, consulting engineer for the Siskiyou Electric Light & Power Company, is on the Klamath River development, after spending a few days at his San Francisco office.

J. E. Crilly, and H. C. McCutchan, of the sales department of the Holabird-Reynolds Company, have returned to San Francisco after spending two weeks at the works of the Ohio Brass Company at Mansfield, Ohio.

James Churchill and Jesse Churchill, of Yreka, who are connected with the management of the Siskiyou Electric Power & Light Company, which is extending its system by constructing a hydro-electric plant on the Klamath River, are among the recent arrivals at San Francisco.

F. O. Dolson, electrical engineer with the Pelton Water Wheel Company, has returned to San Francisco from Bodie, after completing the installation of a 2500 h.p. Pelton water wheel at the Pacific Power Companys new electric power station, which supplies current for mines and towns in that district.

P. T. Hanscom, general superintendent of the Great Western Power Company, states that construction work wa. recently suspended for the winter at the site of the great impounding dam at Big Meadows. A construction plant of large capacity has been installed and work will be resumed early next season with a large force of men.

A. J. Myers, Pacific Coast district manager for the Wagner Electric Manufacturing Company, of St. Louis, has returned after visiting Los Angeles, to his San Francisco office which is now located on the ground floor of the Rialto Building. D. D. Wright, who is connected with the sales department, was in charge of the office during Myers' absence.

C. F. Flinn, electrical engineer, who was for some time connected with the sales department of the Allis-Chalmers Company's San Francisco office, has been made manager of all of the L. E. White Lumber Company's extensive interests at Greenwood, Mendocino County. A new power house, equipped with high-pressure marine-type boilers and a steam turbine generating set is to be constructed at the plant.

TRADE NOTES.

O. W. Lilliard, Pacific Coast manager of the Gould Storage Battery Company, with works at Depew, N. J., has removed his San Francisco offices to 902-904 Rialto Building, San Francisco.

The Bellingham & Skagit Railroad Company, Bellingham, Wash., has placed an order with the Westinghouse Electric & Manufacturing Company for four quadruple equipment No. 304 motors with type HL. USS control.

The Tulare County Power Company, through Purchasing Agent Holley, of Lindsay, California, has given an order for Locke insulators to equip 150 miles of transmission line to Pierson, Roeding & Company, and 110 tons of wire to the National Conduit & Cable Company.

The Hawaiian Electric Company, Ltd., Honolulu, T. H., representing the Westinghouse Electric & Mfg. Company, have sold a 125 k.v.a. non-condensing turbine with direct connected exciter and alternating current turbo-generator, 240 volt, 3-phase, 60 cycles, to operate at 3600 r.p.m., using superheated steam, also one three-panel switchboard complete with all meters and synchronizing apparatus. This equipment is for the Hawi Mill & Plantation Company's raw sugar factory. This plant will be operated in parallel with a 75 k.v.a water wheel driven generator 2¼ miles from the factory and delivering current at 2400 volts. Transformers at the factory will step the voltage down to permit of parallel operation with the new unit.

ELECTRICAL CONTRACTORS' NOTES.

Paul Butte returned from Portland after a two weeks' business trip.

Levy Electric Company have moved to a fine large store at 539 Market Street.

The John G Sutton Company have been awarded the electrical work for St. Luke's Hospital, at approximately $15,000. L. P. Hobart is the architect.

Newberry, Benheim Company have opened a place in Chicago in charge of Mr. Benheim, who has had charge of the San Francisco and Los Angeles offices. In addition to the above places the firm have offices in St. Louis and New Orleans.

There is much speculation going on in reference to who will be the next chief of the Department of Electricity, and at present every one is guessing. The entire electrical fraternity should be heard from on this important subject, as there is no doubt that the incoming administration will be a business one and from no better source can a recommendation come than from the men whose business is practically controlled by the Department of Electricity. The contractors want a business administration and owing to the annoyances of changing administrations it is to be hoped that the Department of Electricity will be taken out of politics. In order to successfully perform the duties laid out for the department its chief should be a first class business man with good executive ability, have a thorough working knowledge of electrical construction and at all times be able to look at matters coming before him in such a manner as to know that the consumer has certain rights as well as the electrical tradesman, and at all times remember that "safety" is the watchword.

A GOOD IDEA FOR CONSULTING ENGINEERS.

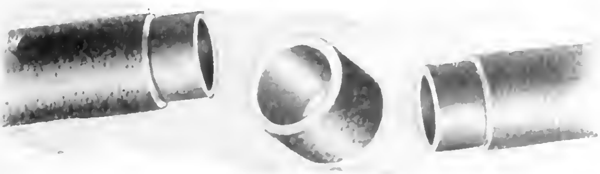
William S. Turner, consulting engineer, Spalding Building, Portland, Oregon, is distributing a neat booklet which contains a summary of his professional experience and a list of the concerns for whom he has performed various classes of engineering work. This booklet is at once dignified and effective.

INDUSTRIAL

FIBRE CONDUIT FOR SUBWAY DISTRIBUTION SYSTEMS

Fibre conduit is the most recent addition in materials for subway distribution systems that has been developed to meet the new conditions of service. It has been in use about eight years and is formed in cylindrical shape from fibre or wood pulp under pressure. The wood pulp is thoroughly saturated with a bituminous compound and any vegetable matter or bacteria which would tend to promote decay is killed by the presence of about 6 per cent of creosote salts in solution. There are at the present time two types in general use, known as straight joint and bell and spigot joint conduit, made in four styles of joint to meet the general conditions of service, namely [illegible] joint, sleeve joint, drive joint and screw joint, furnished in either 1 in., $1\frac{1}{2}$ in., 2 in., $2\frac{1}{2}$ in., 3 in., $3\frac{1}{2}$ in. and [illegible] sizes. It has been shown that fibre conduit will stand an average puncture test of 32,000 volts dry and [illegible] volts after immersion in water for 200 hours.

[illegible]



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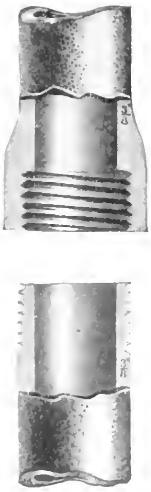

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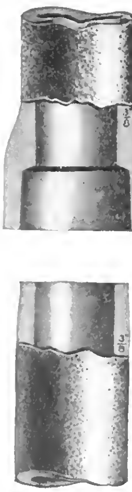


[illegible] Bell Joint

In the introduction of this material on the market there were objections to be overcome, the most serious [illegible] to the life compared with the older styles of conduit which had been tried out, and during the eight years of development this point has been one of greatest discussion and observation, resulting in numerous laboratory and service tests. Samples recently excavated from the first installations show no deterioration, either mechanically or electrically, and while it is safe to say that fibre conduit will last indefinitely, no one is in position to tell whether impregnated fibre will last for more than fifty years, and in basing our calculations on the future, the only thing to do is to cite cases which are similar as possible.

It is a well known fact that objects have been [illegible]terred and found to be wrapped in cloth saturated in asphalt, evidently having been buried for hundreds of years, the asphalt in the cloth showing no deterioration except [illegible] become hard. Coal tar pitch and alleged wool felt [illegible] usually a combination of old rags, wood pulp, straw [illegible] cotton and jute, was taken out of the subway which was built by the New York Central & Hudson River Railroad approximately 35 to 40 years ago, and found to be in perfect condition. However, there is no cause to wonder at this performance, simply because these bituminous substances preserve this material indefinitely when oxygen and the actinic rays of the sun are not a factor and destroying agent, and this is the case when a piece of conduit is buried in the ground. Furthermore, the creosote salts positively fumigate the material and stop mould and rot. There are roofs of buildings that have been subjected to oxygen and the [illegible] rays of the sun, made of bituminous compounds similar to that which is used for impregnating fibre conduit, that [illegible] given good service for more than thirty years. It is [illegible] a well known fact that railroad ties treated with an oil [illegible] which creosote occurs in sufficient quantity are immune to rot and decay and their life has not been determined, inasmuch as ties are now in service that were treated with car[illegible]neum more than twenty-five years ago, and carbolineum is nothing more than creosote oil.

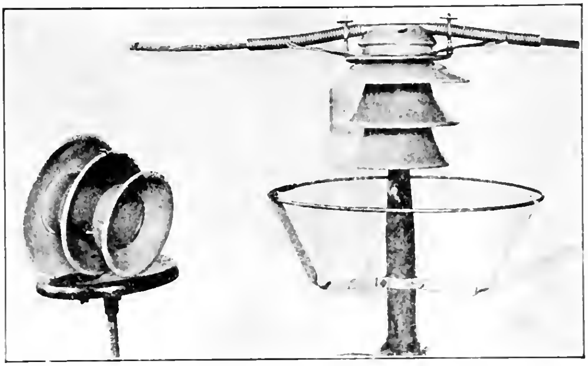
It has been found that about 90 per cent of all cable troubles are directly traceable to some injury to the lead [illegible]sing when being drawn into the duct, due to the roughness of the walls, and the cement which has seeped through the joint [illegible] formed cutting edges after hardening. Cable [illegible] also due to high currents leaking through the [illegible] result of improper installation and the impos[illegible] securing perfect alignment. These objections, however, [illegible] eliminated by the use of fibre conduit, due to the [illegible] interior and water-tight joints. Unlike joining [illegible] the connection made with fibre conduit is [illegible] affording perfect alignment without the use of man[illegible] not having to use cement, mortar [illegible] the joints.

[illegible] that fibre conduit is impervious to moist[illegible] or other corrosive elements, thus water, gas [illegible]nts cannot reach the cable protected by this

material. It is a good non-conductor, doing away entirely with the trouble with stray currents, and is also an absolute prevention against electrolysis, which destroys many cables, gas and water pipes during each year. It is known that a pressure of five volts will destroy a water pipe or cable in about nine years, and there are few railways, light and power companies, who have not been troubled with electrolysis. In the event of short circuit the wall immediately surrounding the arc may char but the fire will not spread, resulting in the easy removal of the cables from the ducts.

In figuring on subway installations, it has been fully demonstrated by experience of the largest operating companies that on account of the lightness in weight, large savings can be effected in freight, trucking, excavating, handling, laying and the amount of concrete necessary. In shipping and handling fibre conduit, breakage is practically nothing, due to the great tensile strength of the wall and the shock resisting properties of the material.

Socket Bell Joint



Nicholson Arcing Ring

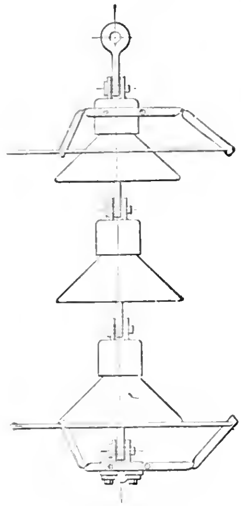


Diagram of Nicholson Ring

Samples of conduit which were placed in an oven and the temperature greatly raised show that at 135 degrees Fahr., softening of the compound began, and that at 205 degrees the compound became very soft, but the mechanical strength of the material was such that the samples retained their shape, and the effect was on the impregnating compound, only.

Fibre conduit has been known to withstand temperatures of 330 degrees satisfactorily. However, in actual service, the high temperatures named are not likely to occur, as the cable insulation would give way, and in giving these temperatures it is to illustrate the heat resisting qualities of fibre conduit under conditions other than normal.

THE NICHOLSON ARCING RING.

The Nicholson Arcing Ring which has been taken over exclusively for manufacture and sale by The Locke Insulator Mfg. Co. of Victor, N. Y., is apparently a near approach to the solution of much of the lightning trouble upon power transmission lines. Ordinarily, after a lightning storm, a lineman finds the insulator shot to pieces and it is usually construed as a punctured insulator. The fact probably is that due to an indirect stroke of lightning, that is to say, within a matter of a quarter of a mile or less of the line, surges have been induced upon the line causing the insulator to flashover and the power arc which follows, being naturally concentrated under the shells of the insulator in grounding to the pin, mechanically ruptures the insulator due to the concentrated heat of the arc and after the shells are thus cracked from this heat the current follows, creating the destructive effect noticed. Upon this analysis the arcing ring was based and its use up to the present time shows it to be correct. The installation of arcing rings allows flashover to take place between the upper ring, which is connected to the line cable, and the lower ring, which is grounded to the cross-arm or pin and the lower ring is so removed from the insulator as to avoid the heating above referred to. After the circuit breakers have gone out it has been demonstrated that the line can be tied in again and the insulators are intact. This result is of course very gratifying as compared with the old condition of finding the line grounded through ruptured insulators, in which case it was necessary to send out linemen to make repairs before operation could be resumed. It will be immediately apparent that these appliances are specially valuable in the case of an important power load being carried on a single circuit where the load cannot be transferred to a duplicate line. Or it is valuable again in the case of isolated, inaccessible portions of a line where repairs are laboriously and expensively made.

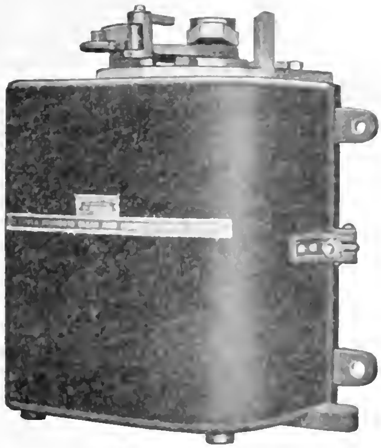
The most conspicuous example of the use of these rings has been in the case of the Niagara, Lockport & Ontario Power Company and Mr. Nicholson presented the features of this installation to the American Institute at the Charlotte meeting last year.

Very many ideas have been held regarding the service to be performed by high voltage insulators; some engineers intend them to serve as an absolute preventative of line discharges, depending upon lightning arresters and ground wires; others have considered making the insulator rugged enough to remain intact as a result of flashover, intending such line flashover to save destruction in the power house, but in no case has it been shown that it is safe to consider the insulators other than special pieces of apparatus which are in a sense frail and should be protected against destructive discharges as in the case of any other piece of apparatus.

Pierson, Roeding & Company of San Francisco, Portland, Seattle and Los Angeles, is the Pacific Coast representative for the Locke Insulator Mfg. Co.

SAFETY LIMIT STOP FOR ELECTRIC CRANES.

Those experienced in electric hoist or crane service know that with the ordinary limit switch which merely cuts off the current from the motor, the stopping point varies considerably. If the limit is set low enough to prevent dangerous over-travel of the hoist block when the hook is light and at high speed, a loaded hook coming up at slow speed will stop below the desired point. The drift of the motor and hook depends on the square of the hoisting speed and the load on the crane hook. Adjustment which suits one condition does not provide for all.



Palmer Safety Limit Stop

The new Palmer Safety Limit Stop put on the market by The Cutler-Hammer Mfg. Company of Milwaukee will bring the hoist block to rest within two inches of any desired point regardless of whether the hook is light or heavily loaded, or whether the speed is high or low. This safety stop is not geared to the hoist nor operated by a traveling nut, but is operated by a trip rope. The motor circuit is opened and the series field connected across the armature when the hoist block reaches a predetermined point. The dynamic braking action brings the hook to rest promptly. The device is enclosed in a substantial case and is made in capacities up to 25 h.p. 110 volts and up to 50 h.p. 220 or 550 volts.

IMPORTANT ANNOUNCEMENT.

On January 1st, 1912, the agency agreement for the sale of O-B overhead materials, rail bonds and car equipment specialties, which has been in force between The Ohio Brass Company, of Mansfield, Ohio, and the Pierson-Roeding Company, of San Francisco, for a number of years, terminates and will not be renewed, as it was mutually agreed that separate agency agreements for O-B hi-tension insulators and O-B electric railway equipment would eventually prove unsatisfactory and that the interests of all concerned would be better served by a single agency for the entire O-B line.

On and after January 1st, 1912, the Holabird-Reynolds Company, of San Francisco, who, for some time past, have been acting as exclusive agents for O-B hi-tension insulators only, will become the exclusive agents of The Ohio Brass Company for the sale of its entire line in the State of California.

The Holabird-Reynolds Company will carry an adequate stock of O-B railway materials and hi-tension insulators in San Francisco and business in Los Angeles and the southern part of the State will be handled by Mr. H. C. McCutcheon of their Los Angeles office, under the personal direction of Mr. R. D. Holabird.

The business in the States of Washington, Oregon, Idaho and in British Columbia will be in charge of the Company's own personal representative, Mr. F. V. Cook, who will make his headquarters in Seattle, at the office of the Holabird Electric Company. An intimate and friendly business connection between that comany and The Ohio Brass Company will be maintained because of their California Agency for O-B materials. Arrangements are being made to carry an emergency stock for quick delivery in Seattle.

Every effort will be made to handle all orders and inquiries in such a way as to merit a continuance of patronage and to render O-B service eminently satisfactory to Pacific Coast customers from every standpoint of price, delivery and quality of materials furnished.

ADVERTISING ELECTRIC VEHICLES.

A fund of at least $50,000 is being raised and will be expended by the Electric Vehicle Association of America, comprising central stations and the manufacturers of electric vehicles, batteries and accessories. The leading magazines, national weeklies and trade journals will be used for the publication of a series of convincingly worded advertisements, attractively illustrated to popularize the electric vehicle throughout the country. Articles along the same line, containing real news, will also be furnished these publications.

The advertising that has been done hitherto by manufacturers of electric vehicles has been selective advertising by means of which each advertiser hopes to cause the prospect to select his particular make. The Electric Vehicle Association believes that this national and general advertising campaign on the merits of the electric vehicle will make individual advertising of the same sort far more effective than it now is and largely reduce selling costs.

The members of the Association's Publicity and Advertising Committee, whose names guarantee that the advertising will be impartially conducted are as follows:

Charles L. Edgar, chairman, Boston, Mass.; N. F. Brady, New York, N. Y.; G. W. Brine, Atlanta, Ga.; John A. Britton, San Francisco, Cal.; H. M. Byllesby, Chicago, Ill.; W. W. Freeman, Brooklyn, N. Y.; Frank W. Frueauff, Denver, Colo.; George H. Harries, Washington, D. C.; Charles R. Huntley, Buffalo, N. Y.; Samuel Insull, Chicago, Ill.; Arthur B. Lisle, Providence, R. I.; J. B. McCall, Philadelphia, Pa.; T. N. McCarter, Newark, N. J.; Alten S. Miller, St. Louis, Mo.; John B. Miller, Los Angeles, Cal.; R. F. Pack, Toronto, Ontario; Samuel Scovil, Cleveland, Ohio; R. M. Searle, Rochester, N. Y.; J. G. White, New York, N. Y.; ex-Officio W. H. Blood, Jr., President, Boston, Mass.

The prompt and generous co-operation of all interested in increasing the use of the electric vehicle is necessary to make this campaign the fullest possible success, and those who have not yet done so are urged to immediately send their subscriptions to Mr. W. H. Blood, Jr., president Electric Vehicle Association of America, 147 Milk street, Boston, Mass., who is personally supervising the raising of the advertising fund.

NEW CATALOGUES.

The General Electric Company has recently issued several interesting new bulletins. No. 4912 is devoted to ozone [illegible] purification; No. 4902 lists d.c. switchboards [illegible] volts for controlling 3-wire generators; No. [illegible] and describes G. E. Edison Mazda lamps for [illegible] lighting service; No. 4908 is devoted to the subject [illegible] hotels, cafes and clubs, and No. 4895, which is attractively printed in colors, contains descriptions and illustrations of fans for use in the home, office and public places.

NOTICE OF ERRATA.

In the article on Storage Battery for Goldfield Mines, appearing in this journal of Dec. 30, 1911, the captions of Fig. [illegible] and Fig. [illegible], as well as Fig. 9 and Fig. 10, should be [illegible].

NEWS NOTES

INCORPORATIONS.

PRESTON, IDAHO.—Articles of incorporation for the Idaho-Utah Electric Company of this city have been filed at Boise. The company will provide power and light for Preston and other nearby towns.

BOISE, IDAHO.—Articles of incorporation for the Cleveland Construction Company, an electrical power and railroad corporation, have been filed here. F. A. Little of this city, has been designated as agent for the company, which is an Ohio corporation.

OLYMPIA, WASH.—Articles of incorporation for the Western Washington Water Power Company, incorporated at Portland, Me., November 10th, 1911, have been filed here. The officers of the company are Alvah Todd, president, and Clement Ford, secretary.

LAPWAI, IDAHO.—The Tom Beall Telephone Company has filed articles of incorporation and will construct a telephone line from Lapwai to Tom Beall Creek. Capitalization, $10,000. Incorporators are W. W. Olds, Dan Moore, J. W. Fenderson, J. J. Hogaboam, G. N. Elliott, D. G. Hogaboam and Ira F. King.

EL CENTRO, CAL.—Mt. Signal Water Company has incorporated with a capital stock of $125,000. The incorporators are F. A. Roeding, Manley Roswell, J. H. Lein, G. W. Nichols and S. A. Embury, all of El Centro. The plan is to undertake the project of bringing under irrigation about 25,000 acres of land on the west side of the Imperial Valley.

KIRKLAND, WASH.—The Kirkland-Redmond Railway, Light & Power Company of Seattle has filed articles of incorporation at Olympia. Capital, $200,000. Incorporators are C. A. Eaton, B. F. Gordon, Wm. Perigo, Samuel G. Hepler and W. D. Gillis. They propose to construct a railway between Kirkland and Redmond, and to erect a power plant at Kirkland.

ILLUMINATION.

TULARE, CAL.—An application from the Tulare Power Company asking the Board to advertise a franchise for sale, has been filed.

CHEHALIS, WASH.—The County Commissioners have granted a 50-year light franchise for Adna to the Washington-Oregon Corporation.

LOS ANGELES, CAL.—J. W. Carton & Company, contractors, are to furnish and install complete a power plant for the Beverly Hills Hotel, Beverly, Cal., for $10,775.

SANTA MONICA, CAL.—The warehouse of the Southern California Edison Company, located at Eighth and Colorado avenue, has been destroyed by fire, entailing a loss of about $35,000.

CHICO, CAL.—The Sacramento Valley Power Company, a new electric corporation, has been awarded a contract for furnishing electricity for street lighting purposes for the next three years, at a contract price of about $11,000.

SACRAMENTO, CAL.—Bids for the erection of a power house at the Southern California State Hospital were received by State Engineer Ellery. F. M. Walton of Hollywood, bid $11,115, and David Irvine of Riverside, $11,896.

KINGMAN, ARIZ. The Santa Fe Company here is planning to install electricity in all buildings and yards of the company. Work is to start after the first of the year. The Desert Power & Water Company will supply the power.

DOUGLAS, ARIZ.—The Douglas Power Company will probably extend a power line from the county farm through the valley in the next few months. The merger of public utilities companies in Douglas means enlargement and improvement.

KLAMATH FALLS, ORE.—Messrs. Jesse W. and Jerome P. Churchill, Alex. J. Roseborough and Mr. De Trestain of the Siskiyou Light & Power Company, also owners of the Klamath Light & Water Company, have asked for a light and water franchise.

CATHLAMET, WASH.—M. Haycox of Portland is seeking a franchise for an electric light plant here, and the construction of a dam in Elocoman River. The proposed plant will cost $15,000. The application will come before the town council in January.

YUBA CITY, CAL.—The Live Oak & Encinal Light & Power Company, which for several years has been supplying the town of Live Oak and vicinity and the country south of town as far as Encinal, have gone out of existence, and the Pacific Gas & Electric Company has taken control.

PORT TOWNSEND, WASH.—With the old year the coal oil lamp at Fort Flagler has disappeared and its place taken by an electric signal, as a result of the completion of a power plant at that fort. The wires for lighting the various buildings, streets and parade grounds are laid under ground, 100 c.p. lights being used for illuminating the streets and parade grounds. Forts Worden and Casey have been lighted with electricity for some months. In addition to the lighting plants all three forts have been equipped with searchlights and such stations extend from the forts several miles along the shore line at stated distances apart.

GLENDALE, CAL.—The new street system for Glendale includes the construction of five light iron standards constructed every 100 feet along each side of Fourth street from Central avenue to Everett street, on Brand boulevard from Third street to Sixth street, and along Glendale avenue from Third street to Fifth street. After the improvement is completed the maintenance of the lights will cost the city of Glendale about $100 a month. In connection with this improvement the Pacific Telephone and Telegraph Company is putting all of its lines along the streets to be improved, under ground, so as to do away with the large number of poles now standing along the streets.

TRANSPORATION.

MODESTO, CAL.—Preliminary work on the Stanislaus River bridge for the San Joaquin Valley Electric Railroad has been awarded to the Pacific Construction Company.

SACRAMENTO, CAL.—The bid of the Sacramento Electric, Gas & Railway Company for annexed territory was accepted and the ordinance passed, granting the franchise.

LOS ANGELES, CAL. The one offer made for the electric railway franchise along Washington street easterly from Pasadena, was by the Pacific Electric Company, at $100, and was accepted. Work will start at once.

LOS ANGELES, CAL. The $5000 bid of the Los Angeles Railway Company for the crosstown car line franchise under which lines will be established on Jefferson street, Vernon avenue and Vermont avenue, was accepted.

EMMETT, IDAHO.—The Idaho-Oregon Light & Power Company will build a 112 ft. dam in the Black Canyon of the Payette River, about 6 miles above here, in the near future. Cost will be $250,000.

EL CENTRO, CAL.—Five carloads of machinery for the producer gas electric power plant of the Holton Power Company, have arrived. This shipment includes the huge generator, and the gas-producer engine.

CALISTOGA, CAL.—J. T. York of Napa his asked for a franchise for the San Francisco, Napa & Calistoga Electric Railroad Company, to run their line into the town of Calistoga. An adjourned meeting will be held to settle the matter.

CALISTOGA, CAL.—Superintendent M. McIntyre and Attorney John T. York of the San Francisco, Napa & Calistoga Railway, appeared before the town board on Tuesday and applied for a franchise to run the electric cars upon the streets and thoroughfares of Calistoga and the request was granted.

PASADENA, CAL.—A compromise has been reached between the City Council and the Pacific Electric Railway concerning the franchise for a car line out Washington street. The line will be built, opening to transportation the northwest section of the city and Nazarine University. The franchise has been amended to read 19 years.

SACRAMENTO, CAL.—The Northern Electric has closed a lease for operation of the Sacramento-Woodland electric line as soon as the road is completed. The lease will extend until the company can secure its rolling stock and provide an operation department. The Sacramento-Woodland line will cross the tule land on a trestle 8800 feet long that is under construction. One hundred cars of steel rails are on the way to this city from Pittsburg for use in building the line.

BERKELEY, CAL.—Beginning December [illegible] all Southern Pacific local trains running into Berkeley were electrically propelled. For some time, partial electric service has been in vogue on the Shattuck avenue line, steam trains being run during the hours when the traffic was the heaviest. Another large residential district is afforded through train and ferry service by the opening of the new Ellsworth street line from the Oakland mole to Alston way, near the entrance to the State University.

SEATTLE, WASH.—The name of the Seattle-Everett Traction Company has been changed to the Pacific Northwest Traction Company and the Seattle-Everett system and the Bellingham-Skagit line, now under construction, have been brought into one corporation under the new name. The Pacific Northwest Traction Company is capitalized at $[illegible],000,000. Questions of economy and convenience in operating the Seattle-Everett line and the Bellingham-Skagit line were responsible for the merger of the two systems and the adoption of one name for the consolidated line.

SACRAMENTO, CAL.—The Oakland, Antioch & Eastern Railway Company has applied for franchises to operate interurban electric trains into this city across the Sacramento River and through several of the streets, some of which are already occupied by interurban and street car franchises. The road will enter the city from the west over a big steel bridge now being constructed by the Northern Electric, Vallejo Northern and Sacramento-Woodland electric lines, and will build down the west side of the Sacramento River through the reclamation districts of Yolo County.

TELEPHONE AND TELEGRAPH.

KENNEWICK, WASH.—Manager A. F. Brown of the Kennewick Valley Telephone Company, announces that $[illegible] will be expended in improvements. A modern common battery system will be installed, thus doing away with the present "ringing-for-central" method.

PORTLAND, ORE.—The Home Telephone & Telegraph Company has filed a suit in the United States Circuit Court against the City of Portland to restrain it from interfering with the operation of its business and the recovery of such damages as the court may determine. The complaint alleges that the servants of the defendant city have threatened to enforce against it ordinance No. 19626, which refers to the stringing of wires and erection of poles, that if enforced would cause the plaintiff great expense and annoyance. It is also alleged that no other company operating wires and poles in the city has been subjected to this ordinance, although it was passed June 1, 1909.

WATERWORKS.

PASADENA, CAL.—The proposition of voting $40,000 for the purchase of a reduction plant, will be settled Feb. 7.

ELMA, WASH.—The contract for the construction of a water system has been awarded to Welton, Kibbe & Cochran of Portland, Oregon.

HUNTINGTON PARK, CAL.—Three proposed bond issues have been defeated: $60,000 for a water system, $10,000 for an electric plant, $10,000 for fire protection.

FALLON, NEV.—Sealed bids will be received up to January 17, and at that time publicly opened and read for the materials and construction of a complete waterworks system.

ELLENSBURG, WASH.—It is believed that the contract for the construction of the municipal waterworks system will be awarded to the International Contract Company of Seattle who offers to do the work for $122,280.

SPOKANE, WASH.—Plans for the $200,000 high pressure water main system for better fire protection in the downtown district have been forwarded to Special Agent McKenzie, representing the Board of Fire Underwriters for Washington.

SUTHERLIN, ORE.—An ordinance authorizing the Common Council of the city to construct and maintain a system of waterworks and providing for the issuance of bonds for $[illegible],000 for providing funds therefor, will be voted on at the next election.

SAN FRANCISCO, CAL.—The Board of Public Works has advertised for bids for work which includes the general construction of the second pumping station of the salt water fire system for Fort Mason Reservation; the structural steel for the same and the mechanical equipment for the building.

TACOMA, WASH.—Two additional springs will be tapped at the headworks of the municipal water plant by a project [illegible] proposed by Councilman S. W. Greenwood and Water Superintendent C. S. Watters. The plan is to lay a 12 inch [illegible] round the base of the hill, tapping the two springs now being used.

REDMOND, ORE.—The Council has passed an ordinance providing for the issuance of negotiable coupon bonds of the [illegible] in the aggregate amount of $27,000 for the purpose of acquiring waterworks. The bonds to consist of 27 in number in the denomination of $1000 each, numbered consecutively [illegible] inclusive, payable in the order of their [illegible] hed. Rate 7 per cent per annum, payable [illegible] the 1st of May and November of each year.

[illegible] CAL.—The following bids for the water plant [illegible] were received: C. D. Vincent, $31,595.25; Cham[illegible] $[illegible]; Western Engineering & Construction [illegible] Central California Construction Co., $32,[illegible] $32,100 Henry R. Worthington Co., pump[illegible] $[illegible].75; Smith, Booth, Usher Co., tanks and [illegible] Byron Jackson Pump Co., by J. M. [illegible] $[illegible]. The contract was awarded to [illegible] Oakland.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JANUARY 13, 1912 | NUMBER 2

ELECTRIC MOTORS FOR OIL WELL SERVICE

BY S. G. GASSAWAY.

The application of electric motors to oil-well work is not new, although their use in the California fields is comparatively recent. In the South Penn. fields at Folsom, W. Va., there are some 450 motors which have been in satisfactory operation for four years or more. The conditions and practices in the California fields are quite different from those of the eastern fields and require a different method of treatment in applying electric power. This necessitated some experimenting before a suitable motor was designed. After an elaborate and careful series of tests, the manufacturers are today able to offer a design of electric motor suitable for each particular set of conditions and which is actually even more reliable for all duties, except possibly drilling, than our old standby, the steam engine. The power companies are fast extending their lines throughout the fields and it is now only a question of a few weeks when every lease will be in reach of electric service. Today there are over 300 electric motors in operation on oil wells in the Coalinga, Kern, West Side and Los Angeles fields. A number of these motors have been in operation over ten months.

Oil Pumping Rigs in Coalinga Field of California

From the standpoint of reliability, simplicity, ease and cost of operation, the induction type of motor has been generally adopted for oil work. There are several forms or types, namely, constant speed, two speed, variable speed, star and delta wound, back geared and belted, and many combinations of these.

The Kern River Oilfields of California, Limited, are installing 233 motors on their "33" and Imperial leases in the Kern River field. The back geared, star-delta, variable speed type of induction motor has been adopted as most suitable for their conditions, after a careful investigation by their engineers. The first five of these motors were put in operation May 30th, 1911, and today there are 60 motors in operation. The results have been most gratifying, electric power effecting a reduction in operating expense of 45 per cent.

The motors are provided with a switch so as to connect the winding in star or delta. With the first set of connections the motors are capable of developing 10 h.p. continuously; on the delta connections the motors will develop 30 h.p. For momentary overloads the motors will develop as high as 75 or 80 h.p., provided the transmission line regulation is good.

For all pumping and pulling operations the motors develop sufficient power on the star or low connection. In cleaning the well it is necessary, in general, to use the high power connection for hoisting the bailer when full and for spudding the bailer with the sand reel. For spudding from the wrist pin and other operations the low power rating is ample.


Belted Variable Speed Motor Pumping on Santa Fe Property at Fellows.


Type of Transformer Bank Used in Oil Fields.

The speed of the motor is varied by means of a controller similar to that used on street cars. This is operated by a lever and wire transmission from the usual place in the derrick. The controller, motor and other accessories are housed at the place formerly occupied by the engine. The motor may be operated continuously on any point of the controller. We operate on the full speed point in pumping as being more economical of power and furnish the correct size of pulley to obtain proper pump stroke. For long pulling or cleaning jobs a larger size of pulley is used to obtain greater speed. The change from one pulley to the other takes less than five minutes. The motor bases are arranged for long travel, so it is unnecessary to change the length of belt for change of pulleys.

A number of the well operators were at first prejudiced against the motors, but in general became proficient in handling them after the first day, although few had ever handled any kind of electrical apparatus before and most of them now prefer the motor to the engine. For cleaning (bailing) the wells the motors are far ahead of steam in ease of operation and expense.

On our wells, which average about 850 ft. in depth, we consume from 100 to 180 kw. hours of electrical energy for the entire job of cleaning, which at 1.2c per kw. hour, makes the cost $1.20 to $2.16. Cleaning requires about a week's time. This power consumption seems hard to believe. The reason for the low cost is that there are no standby losses—(that is, no power consumed while the controller is shut off) and the greater efficiency at low speeds, in starting, and overloads, of the motor over the steam engine. Condensation in the steam pipes goes on whether the engine is running or not and for large overloads the steam consumption is notoriously large.

Cold weather, if anything, reduces the electric power bill and there is no loss due to condensation during rain or snow. Electricity is more economical to transmit than steam and responds more quickly, easier to handle and is just as flexible. The electric motor has greater overload capacity, hence it is practically impossible to stall, will not run away when the rods part, can be reversed more quickly and on pumping duty the speed is regular, which results in less rod breakage, as we find from actual operation.

Below are figures on pumping by steam and by electricity:

COSTS PER WELL PER DAY.

	Steam.	Electricity
Labor, operating (Oilers, well gang, boilermen and electricians)	.60	.40
Maintenance (fuel, water, oil and electric power)	2.55	1.35
	$3.15	$1.75

Saving electricity over steam—$1.40 per well per day.
Reduction in operating expense—44.5 per cent.
(In the above, fuel oil is taken at 40c per barrel).

On the basis of 233 wells, the above means a saving in operating expense of $119,000 per year.

The market price of oil in the Kern River fields today is about 32 cents per barrel at the well. From the figures above, it is obviously out of the question to pump wells by steam when the production falls below ten barrels per day. In the case of electricity, the production can fall as low as 5½ bbl. per day before the cost equals the selling price of the product. In the eastern fields, where the oil is of a paraffine base, wells are actually pumped by electricity which only produce two and three barrels per day. (The price of oil of course is higher and the wells are only pumped a few hours a day.)

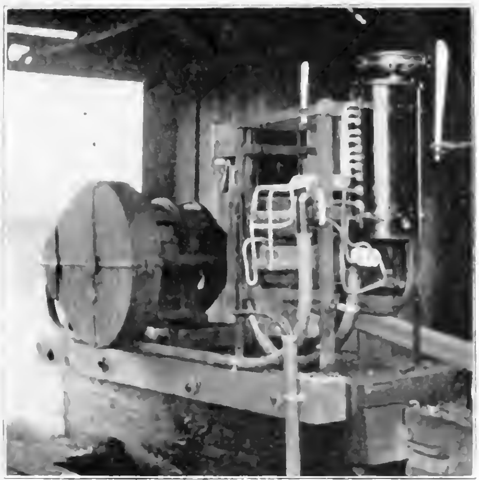
In installing motors advantage should be taken of all improvements as far as consistent with reliable operation. Price should by no means be the determining factor, as can readily be shown. Assume a 25 bbl. well-oil at 30 cents. The value of the product is $7.50 per day. Assume cost of motor, less accessories, as $200 and life 10 years. This equals $20 per year, or about 6 cents per day, or the value of the production for ¼ hour. It is obvious that we can afford to pay 9 cents a day for our motor, or 50 per cent more, if we can save a shut-down per day of 7½ minutes or 3½ hours per month. That is, we should be willing to pay more for the motor which will have less bearing, collector ring, brush or other troubles, with resulting fewer and shorter shut-downs.

Obviously, we should not purchase a motor just because it is larger or stronger than some other motor. Each particular field requires separate investigation. What is satisfactory in one field may not be so in another, likewise the transmission line and transformer layout can only be intelligently and properly designed

by a study of the actual conditions on the ground. "Rushing into the thing," as it were, has resulted in many costly mistakes, which have in some measure, prejudiced oil operators against the motor.

An objection offered to replacing steam by electricity is the time necessary to shut down the wells with its consequent loss of production. This is true, but is not so serious a matter as imagined, for with proper organization and planning, the time should be reduced to a negligible quantity. In our work it has averaged just 30 hours from the time steam is shut off until the well is on the beam again. This could be cut in two by working a day and night shift or in three by working three shifts.

The question arises, what is to become of the extensive system of steam pipes, boilers, etc., which represent a considerable investment. These will be useless except a very small part for heating oil and buildings. It will probably be impossible to recover anything on the steam pipes that are buried in the ground the boilers, pumps and engines will have



Back Geared Variable Speed Motor Pumping at Santa Fe Property, Near Fellows

some service value. Assume however, that nothing can be realized. (If the property is an old one—having operated for five or six years then the steam system should be at least half paid for in the amount set aside for depreciation). The cost of electrification varies from \$675 to \$900 per well, depending upon type and size of motor, method of installation, transmission line and transformer layout. Assume \$750 as the cost. With a saving of \$1.40 per well per day, the electrical installation would pay for itself in 535 days or eighteen months, not counting Sundays. In two and a half to three years it would pay for itself and the full service value of the steam system. After three years the saving of \$1.40 per well per day would be clear profit. Instead of setting aside the total saving effected by electricity, a sinking fund of 25 cents per day at 6 per cent interest will pay off \$750 in seven years.

PUBLIC SERVICE.[1]

BY R. H. BALLARD.

The question of public service and the control of public service corporations is one that in this and other sections of the country is of particular interest to the people at large and the engineer as well as to those who are actively engaged in the service. It has been difficult for some of us who are connected with or a part of public service corporations to fully appreciate that our business is different from the private business of our friends and neighbors.

A comparatively few years ago, public service corporations, about which so much is said today, were unknown, and the business now being done by these corporations was generally limited to a very confined radius and conducted by individuals who found their own capital was ample to carry on the business as then prevailed. In the last few years, however, the development of the country has been so great that the demands for capital for extension of this class of business were more than could be met by individuals, resulting in the combining of individual efforts in the formation of the corporations of the present day.

There are those who have a feeling that a corporation is some hidden monster antagonistic to the people at large, and "forninst" the government. It is not unusual to meet a man who will say "I know your president, he is a fine man; you have a fine lot of fellows in your company, but I have no use for corporations." This man certainly does not realize that a corporation is simply a collection of men who have come together to work in a co-operative way in some great enterprise that no one man can carry out. We say that the president, other officers and heads of departments work for the corporation. This is a mistake. They are not working for the corporation but in reality are the corporation. If the public has confidence in these men, then they should have confidence in the corporation. These men have a duty to perform in the protection of the property entrusted to their care, which has been purchased with moneys invested by the general public in the enterprise, receipts for which money have been issued in the form of stocks and bonds, as well as efficient, careful operation to permit of the furnishing of the commodity to the public at the lowest possible rates.

It is a common belief that the methods of public service corporations are secretive and that it is their desire to withhold from the public all information pertaining to operation, submitting only such data as may be required by law. It is unfortunate that such belief exists, as I am confident that the modern public service corporation anxiously awaits the time when it may lay all of its affairs before the public with the assurance that such conclusions as are reached regarding its business will be based on all the facts rather than on a possible distortion of one or two items for political purposes. This condition will doubtless be brought about in time through careful and conscientious regulation of the affairs of corporations, including not only the regulation of rates of charge, but service conditions, extensions to plants and properties and the issuance of stocks and bonds.

[1]Address before Los Angeles Section, A. I. E. E., Dec. 19, 1911.

A long step in this direction has been taken in the passage of legislation placing the affairs of public service corporations under the jurisdiction of the Railroad Commission of California. Unfortunately, however, the authority given this commission does not extend to a full regulation of the business of these corporations, and we may, temporarily at least, be forced to meet a condition where the railroad commission will be regulating the issuance of stocks and bonds, and ordering expenditures by the corporation for extensions and improvement, while municipal bodies are fixing the rates to be charged for service. There is a chance that this dual regulation may be inconsistent.

Many benefits will accrue to public service corporations through proper regulation, not the least of which will be the absolute stability of their securities and protection from unnecessary competition.

Investments in tin power houses and cheap and inefficient machinery, for the purpose of competing with an established service by charging rates below cost, would not be permitted under a proper system of regulation. Promoters of these schemes seldom give consideration to maintenance or depreciation as they do not expect to be on hand when expenditures from the depreciation fund become necessary.

Perhaps the most popular feature of corporation regulation is the fixing of rates for service, and unquestionably the valuation of the properties of the corporation is the most important element in rate fixing. There are many theories as to the proper basis to be used for valuation, but no basis will stand the test of time and bring about harmonious conditions between the governing bodies and public service corporations that does not take into consideration all of the facts in relation to the establishment of the property. In most cases, much actual expenditure of time and money has been made to bring the property up to its present state of efficiency for which no adequate compensation has been received, and it is distinctly unfair to consider as a basis of valuation simply the present value of physical property based on present day prices with deductions therefrom for age. In the electrical lighting and power field, the brunt of the development of the art has been borne by the present companies, and enormous sums of money have been expended in experiments and development. Were it not for these, the art would be much less advanced as of today and it would therefore appear that valuations at simply present day prices with no consideration for the cost of development would be in the nature of taking something for nothing, as the companies would receive absolutely no return for the years of work and the money expended in development. If it could be shown by a careful analysis that the earnings of a company in the past had been sufficient to compensate for the cost of these developments, no hardship would be done, but in the majority of cases the earnings in past years have not been sufficient to absorb this, in addition to a fair interest rate on the money invested, and the creation of a proper depreciation fund.

CHILEAN EXPORTS.

Chilean exports amounted to $76,066,122 for the first 9 months of 1911, against $68,651,736 for the same period of 1910. September showed a gain of $1,145,-918, of which mineral products composed 95 per cent.

THE MINIDOKA FEDERAL PROJECT.

The State of Idaho presents to the engineering world at large an interesting feature. Here we find within its borders more Carey land projects than in any other state. The federal law originally provided that one million acres of arid lands would be set aside in each state for Carey land projects. Idaho was quick to grasp the situation. Not only was this million acres soon exhausted, but a second million was asked for and granted and now a third million is being considered.

Not alone are Carey land projects active in this state, however, but the federal government itself has taken an active hand through the Reclamation Service. On November 25th, last, Mr. Barry Dibble, electrical engineer, U. S. Reclamation Service, in charge of the Minidoka power and pumping system, presented an interesting account of this project. The Idaho Society of Engineers, meeting at Boise, was the audience before which this paper was delivered. An abstract taken from this interesting paper appears in the following account:

On the Minidoka project in Southern Idaho the United States Reclamation Service has in operation the largest pumping system that has been undertaken. Here water is pumped for approximately 48,000 acres, the average lift being 66 feet.

Power Plant at Minidoka.

The Minidoka project, as a whole, takes water from the Snake River at the diversion dam near Minidoka. This dam is about 50 feet in height and forms a backwater known as Lake Walcott, which at the level of the spillway crest covers approximately 10,000 acres and holds 53,500 acre-feet. About 200 miles further up the river is the Jackson Lake storage reservoir, the water from which is used during the low stage of the river.

At the diversion dam is located the hydroelectric plant which supplies the power required for pumping and for other purposes about the project. The development uses just about the minimum flow of the river, to which there are prior claims below, so that the water must be allowed to pass down stream.

The power house is a reinforced-concrete structure with steel roof trusses and purlins covered by matched lumber and galvanized corrugated iron. It measures 149 feet long by 50 feet wide and 90 feet high from the bottom of the tail-race to the peak of the roof. It contains five main generator units of the vertical type, each of 2000-h. p. rated capacity, and operating under heads of 46 feet from forebay to tailrace. There are also two 180-h. p. turbine-driven exciters.

Each main unit consists of a single Francis runner, 54 inches in diameter, operating at 200 r. p. m., direct-connected to a 1400-k.v.a. three-phase, 2200-volt generator. The weight of the rotating parts is supported from a thrust bearing mounted above the generator and consisting of two castiron disks in a water-cooled oil bath, the oil being circulated by vanes cut on the rotating face.

Each generator is directly connected to a three-phase air-blast transformer which has a step-up ratio of 2300 volts to 33,000 volts. The 33,000-volt side of the transformer is star-connected, its neutral point being grounded. There are no 2200-volt power-house

buses, each turbine with its generator and transformer operating as an independent unit, while all switching is done from the 33,000-volt side. Here each transformer feeds out through disconnecting and oil switches to one of two sets of busbars. Either bus can be connected, through disconnecting and oil switches, to either one of the two outgoing transmission lines. At the power plant each transmission line is provided with a bank of electrolytic lightning arresters designed for 19,000 volts from line to ground.

Cost Power House. Capacity, 7100 Kw.

	Total Cost.	Per Kilowatt
Building	$ 82,000	$11.70
Hydraulic machinery	73,000	10.30
Electric machinery	83,000	11.80
Freight and hauling	26,200	3.75
Erection	55,500	7.90
Tailrace	60,000	8.50
Roads and telephone lines	7,300	1.10
Camp and permanent quarters	23,200	3.30
Engineering and incidentals	11,100	1.55
Administration charges, etc.	15,000	2.1[illegible]
Total	$[illegible]300	$62.[illegible]

Cost Transmission Line.

	Power-Line Cost Total	Power-Line Cost Per Mile of Line	Pole-Line Cost Total	Pole-Line Cost Per Mile of Line
Surveys and location	$18	$36	$175	$[illegible]
Clearing 100-ft. right-of-way	[illegible]		[illegible]	
Pole and tower line complete, except conductors.				
Material	1,035	2,070	[illegible]	[illegible]
Freight and hauling	257	510	[illegible]	1[illegible]
Labor	802	1,600	1,6[illegible]5	1[illegible]
Conductors (transmission and telephone).				
Material	610	1,[illegible]	2,6[illegible]	[illegible]
Freight and hauling	8[illegible]	67		
Labor	7[illegible]	[illegible]50	6,[illegible]0	[illegible]
Superintendence and clerical	1[illegible]	[illegible]	204	[illegible]
Miscellaneous	30	60	[illegible]7	
Engineering	2[illegible]	46	[illegible]0	
Total	$2,[illegible]60	$[illegible]	$10,[illegible]77	$[illegible]

Transmission Lines.

The transmission system consists of 38.4 miles of 33,000-volt line. Of this 29.7 miles, costing $34,000, is required for the pumping system. One line extends down the north side of the river and furnishes power to several towns on the project. The second line has been built direct to the pumping stations, a distance of 11 miles across country. A tie line also connects the first line to the pumping stations. The ordinary spans, varying from 175 feet to 250 feet, are carried on wooden poles, and at the river crossings spans varying from 700 feet to 1100 feet are supported on steel towers. The new construction is borne on heavy poles 35 feet to 45 feet in length, spaced 250 feet apart. Each of the three copper conductors is a hard-drawn three-strand cable equivalent to No. 5 B. & S. in cross-section.

Pumping Stations.

There are three pumping stations, the first located at the end of the gravity canal and lifting the water to the first level, the second about 1.75 miles distant lifting a portion to the second level, and the third another 0.75 mile distant, raising a final portion to the third level. The first station has a maximum capacity of 600 cu. ft. per second at normal speed. The lift at this station and at each of the others varies from 30 feet to 31 feet. The stations are of the same general design and a description of the first will in general apply to all.

The buildings are of reinforced-concrete with concrete roofs. The first is 140 feet long by 18 feet and 30 feet wide and 45 feet high. It contains four pumping units, each delivering 125 cu. ft. per second, and one delivering 75 cu. ft. per second. Each pump is located in an independent concrete chamber 17 ft. x 16 ft., protected by steel trash racks and steel gages. The pumps are of the vertical-shaft type and have both top and bottom suction. The impellers are 44 inches in diameter and run at 300 r. p. m. When starting a unit the pit gates are lowered and the pit is pumped out, thus reducing the power required from the motors. When operating the pump is submerged in the water. The discharge is controlled by a cylinder gate between the impeller and diffusion vanes, the pumps discharging through a tapered casting into a reinforced-concrete pressure pipe 5 feet 6 inches in diameter. At the discharge end each pipe is closed by a steel-plate flap valve, which floats on the water when the pump is operating.

Each pump is driven by a 600-h. p., three-phase synchronous motor, wound for 2200 volts and provided with auxiliary squirrel-cage windings to increase its starting torque. At starting 600 volts is applied to the motor armature, with the field coils short-circuited. The motor is brought up in this way to nearly synchronous speed as an induction motor, and then the field switch is closed and the motor is automatically synchronized at low voltage. It is then thrown on to the 2200 volt buses.

Originally a small pump delivering 1 cu. ft. per second was provided for emptying the pump pits. This pump took forty minutes to empty one pit, interposing at least this interval between starting successive pumps. To get the pumps back on to the line in rapid succession, a discharge pipe with a valve has been fitted to the manhole of each pump, the pump being thus made to clear its own pit. Before a unit is started this 18 inch valve is opened. Then the unit is started as before and the pit is pumped out while the pump is running at slow speed. As soon as the water level has fallen the pump speeds up and can be synchronized. As the result it now takes only two minutes from the time the pump is started until it can be thrown on to the line, ready for raising the pit gates and beginning pumping. The actual interval between starting successive pumps is about ten minutes, with one operator to perform all the work.

The 30,000 volt transmission lines enter the pumping station through disconnecting switches, to a single set of 30,000 volt busbars. From this bus disconnecting and oil switches lead to five 500 kw. air-blast step-down transformers feeding a common 2200 volt bus.

The second pumping station contains four pumps each rated at 125 cu. ft. per second. Here the transformers for the third station are also installed, together with the switch equipment for all the stations and the principal quarters for the operators. At the third lift are two 125-second-feet and one 75-second-feet pumping units. At present the last pump in each station is being installed.

The final total pumping-station costs will be about as follows:

Pumping Stations.

	Number 1.	Number 2.	Number 3.
Excavation	$2,100	$5,300	$2,000
Building	35,000	40,000	19,500
Hydraulic machinery	27,200	23,000	16,200
Electrical machinery	44,700	42,800	17,300
Freight and hauling	10,300	9,600	5,500
Erection	15,800	14,600	9,300
Camp and permanent quarters	4,000	11,000	500
Engineering and incidentals	5,000	3,000	2,000
Administration charges, etc.	8,500	7,000	5,500
Total	$152,600	$156,300	$77,800
Capacity—cubic feet per second	575	500	325
Cost per second-foot capacity	$265.40	$312.60	$239.40
Pressure pipes, including administration charges	$21,400	$16,500	$20,200
Total length of pressure pipes—feet	849	540	825
Cost per foot	$23.90	$30.30	$24.50
Cost per second-foot of capacity, inculding pressure pipes*	$303.00	$346.00	$301.00

*Average, $318.00.

Operation of the System.

The operation of the entire system has been very satisfactory. There have, of course, been minor troubles to be eliminated, but these are gradually being disposed of, and each year shows more satisfactory results than the previous one. The load has been increasing very rapidly. When it was determined to install the final pumping units in each of the pumping stations it was intended that this should be reserve capacity. It is now thought, however, that all the units will be required during the height of the irrigation period, at least until the settlers learn to use the water economically.

Efficiency of Apparatus.

	Full-Load Efficiencies per Cent	Net Efficiency from water Behind the Dam, per Cent.
Turbines	81.5	81.5
Generators	96.0	78.2
Step-up transformers	98.4	77.0
Transmission line	90.0	69.3
Step-down transformers	98.0	67.9
Motors	94.0	63.8
Pumps	72.5	16.3

Unit Costs of Operation.

Cost of operation depends on many conditions. The cost at Minidoka during the past year has been very low, but it might be increased at any time by a serious accident to an important piece of machinery. It is here that intelligent and alert operators can make themselves worth a good salary by catching the troubles before they develop to a serious extent.

Operation and Maintenance of Power and Pumping Systems.

	Power House.	Transmission Line.	Pumping Stations. No. 1.	No. 2.	No. 3.	Total.
Operation:						
Labor	$5,700	$700	$2,100	$2,100	$2,100	....
Supplies	950	100	200	200	150	....
Repairs.						
Labor	900	600	600	600	400	....
Supplies and material	300	100	100	100	80	....
Superintendence, clerical, camp, etc.	1,700	200	700	700	500	....
General expense and administration	450	50	150	150	100	....
Total operating expense	$10,000	$1,750	$3,850	$3,850	$3,280	$22,730
Depreciation	21,700	3,400	7,600	7,800	3,900	44,400
Total	$31,700	$5,150	$11,450	$11,650	$7,180	$67,130
Annual cost per acre, including depreciation	$0.660	$0.108	$0.239	$0.243	$0.150	$1.40
Operating expense per acre (48,000 acres)	0.208	0.037	0.081	0.081	0.068	0.475

The depreciation of equipment is an important item, although often overlooked. In the following table a rate of depreciation of 5 per cent per annum has been applied to the stations and 10 per cent to the transmission lines. No interest is included, as the money for the work comes from the reclamation fund, which is practically loaned to the settlers without interest. In the table allowance for repairs, etc., has been increased over that so far needed, as this item will undoubtedly increase with time. It is not intended to include the item of depreciation in the annual charge made against the settlers. However, this item will have to be met as time goes on and the machinery wears out. This can be done by paying for replacements as they are needed, and in the meantime the settlers will have the use of their money, which is worth 10 to 12 per cent interest, whereas if the government collected a depreciation fund it would have to hold it without interest.

During the season of 1911 114,000 acre-feet of water were pumped to the average height of 66 feet, equivalent to 7,560,000 acre-feet lifted through 1 foot. The operating cost for this pumping was about $0.003 per acre-foot lifted through 1 foot, and the depreciation amounted to $0.006. Next year more water will be pumped at practically the same total cost, and therefore the unit cost will be reduced.

Summary of Installation Costs.

Power-house and accessories	$433,300
Transmission line	34,000
Pumping stations with pressure pipes	444,800
Total investment on power system	$912,100
Investment per acre (48,000 acres)	$19.00

Summary of Annual Charges.

Operation	$22,730
Depreciation	44,400
Total	$67,130
Per acre (48,000 acres)	$1.40

A total of 14,000,000 kw-hours was delivered to the pumping stations during the year at a cost of $37,000, including depreciation, or $0.0026 per kw-hour. If, as would be necessary in the case of a commercial company, interest, taxes, etc., amounting to, say 10 per cent on the investment in the power house and transmission line, were added, the cost would have been perhaps $0.006 per kw-hour.

LOW ELECTRIC RATES IN MANITOBA'S CAPITAL.

The electric-lighting rates finally adopted by the Winnipeg City Council for its municipal plant are to be the lowest in North America. The schedule is based on the estimated consumption at 3 cents per kilowatt, and ranges from a minimum monthly cost of $0.50 for an average monthly consumption of 12 kilowatts in a 4-room house to $2.10 for an average consumption of 70 kilowatts in a 12-room house. Following this announcement, the local corporation which operates a light and power plant in connection with the street railway reduced its rates to meet those of the city.

A SOUTH AMERICAN REPUBLIC'S IMMIGRATION.

The number of immigrants into Chile between 1850 and 1910 is given by official statistics as 60,970, of whom 19,695 landed during the past four years.

THE INDICATOR CARD.[1]

BY ROBERT SIBLEY

We come now to the study of indicator cards. As the subject is one of such magnitude several lectures will be necessarily devoted to it. In order that we may get a fair start in the fundamentals of this subject, we shall devote this lecture largely to definitions, so that we may have no misunderstandings in succeeding lectures.

Since we have found in previous lectures that the indicator card plays a most important role in the accurate computation of power it will now be well worth our while to investigate the indicator mechanism itself and also the graphical means of constructing a theoretic indicator card.

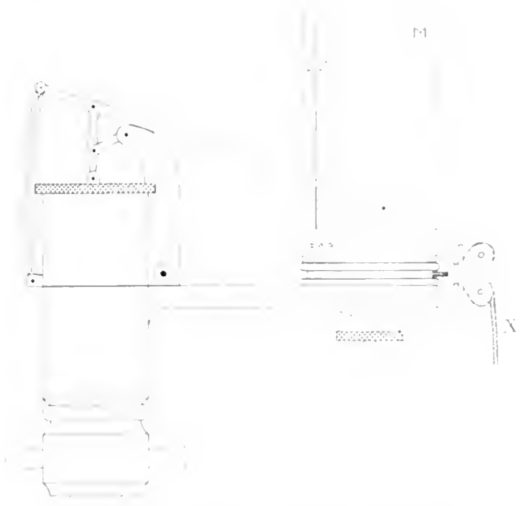


Fig. 1. Typical Outward Ap[illegible]

One of the first things that attracts the attention of the engineer in the early days of his experience is the well-known Bourdon pressure gauge which greets his presence as he enters the boiler room. We have examined the principle underlying this gauge in a previous lecture. Suffice it to say in recapitulation that the underlying principle is merely the expanding and contracting of a hollow steel tube encased within the circular shaped mechanism. An Indicator is nothing but a pressure gauge fundamentally and we shall do well at the start to bear this fact in mind.

We have found in the steam engine cylinder that after cut-off takes place, the steam expands in volume and decreases in pressure, utilizing its own internal reservoir of energy as it does so. We have assumed in former lectures that this expansion takes place isothermally or in mathematical language that the pressure and volume were related to each other according to the law $pv = p_0v_0$, in which p and v are the pressure in pounds per sq. ft. and the volume in cu. ft. of one pound of steam respectively at any stage of the expansion. On the other hand p_0 and v_0 are the pressure and volume at any one given beginning point. In other words we might equally say that the law is simply $pv = k$ in which k is a constant. This then simply means that in isothermal expansion the product of the pressure and volume are at all times constant.

As a matter of fact in the steam engine cylinder the expansion curve is neither isothermal nor adiabatic but has been found by experiment to be intermediate between the two. In other words, this experimental law is $pv^{n} = k$, and consequently this expression is more nearly the law of expansion in the steam engine cylinder.

As this law apparently varies somewhat in every cylinder there early arose among engineers the need [illegible] instrument or mechanism by which a graphical [illegible] could be drawn so as to represent accurately [illegible] which would show accurately to scale each [illegible] any particular point of the stroke. The so [illegible] is simply a mechanical device which accomplishes this result. Fig. 1 shows the general outward appearance of an indicator, while Fig. 2 is a cross sectional view of the same.

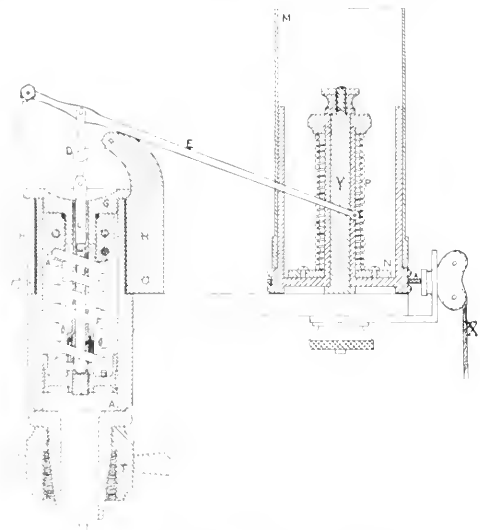


Fig. 2. Cross Sectional View of the Crosby Indicator

A boring is made into one or both ends of the steam cylinder. A connection threaded into this boring is then attached to the lower portion of the indicator shown [illegible] in Figs. 1 and 2. If now we allow the steam to enter from the engine cylinder into the [illegible], the pressure of the steam exerting itself [illegible] the piston B will force the piston upward [illegible] spring [illegible] is very delicately calibrated to represent [illegible] inch of compression so many pounds pressure per sq. in., the height to which the lever arm [illegible] raised measures accurately the steam pressure in the steam engine cylinder. It is necessary [illegible] these pressures are continually changing, to rotate the drum M and as the arm E is raised up and down [illegible] varying pressures in the steam engine cyl-

[1]This paper comprises the Sixteenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

inder, the drum M being rotated will draw off a curve connecting all of these different varying pressures. A typical indicator card is shown in Fig. 3.

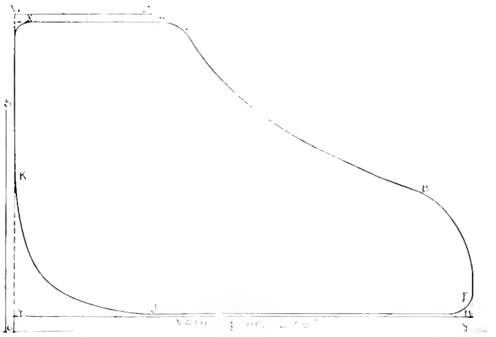


Fig. 3. Typical Indicator Card.

If now we connect the end of the string X to the cross-head of our reciprocating engine the drum M will rotate and the pencil at the extreme end of E will mark upon this drum the curve from which may be obtained the pressure to scale in the cylinder at any particular point of the piston head movement.

The drum M carries the piece of paper upon which the card is printed. This paper is slipped into the forks Z, and as soon as a card is taken the slip of paper is readily drawn out and another card placed upon the drum in its stead. In order that the pencil point at the extreme end of E may trace off an even vertical line, the straight line motion shown at D has been invented. Among the various indicating mechanisms on the market, many of course will be found to have different designs in order to accomplish this straight line result. The particular illustration shown in Fig. 2 is that of the Crosby Indicator.

As the stroke of the engine is usually greater than 12 inches and may be often greater than 60 inches, it is evident that some sort of reducing mechanism must be utilized in the operation of the string or our cylinder will be revolved more than once. Since this would produce much confusion and result in many inaccuracies various designs for reducing mechanisms are to be found in the market. The indicator card itself seldom exceeds four inches in width and two inches in height, consequently it is seen that this reducing mechanism is absolutely essential in the proper operation of the indicator.

Looking now at Fig. 3, let us familiarize ourselves with the fundamentals of the indicator card.

The Atmospheric Line, V H, is a line drawn by the pencil of the indicator when the connections with the engine cylinder above described are closed and both sides of the piston are open to the atmosphere.

The Vacuum Line, O Y, is a reference line known as the line of absolute zero pressure and which we have found to be about 14.7 lb. by scale below the atmospheric line.

The Clearance Line, O S, is a reference line drawn at a distance from the end of the diagram equal to the same per cent of its length as the clearance and waste-room is of the piston displacement. We shall see in our next lecture how to locate this line from an actual indicator card.

The Line of Boiler pressure, WZ, is drawn parallel to the atmospheric line, and at a distance above it by scale equal to the boiler pressure shown by the gauge.

The Steam Line, X A, is drawn when the steam-valve is open and steam is being admitted to the cylinder.

The Point of Cut-off, Q, is the point where the admission of steam is stopped by the closing of the valve. It is often difficult to determine this point. We shall see in our next lecture how to arrive at this, however, agreeable to rules of the American Society of Mechanical Engineers.

The Expansion Curve, Q B, shows the fall in pressure as the steam in the cylinder expands doing work.

The Point of Release, Q, shows where the exhaust-valve opens.

The Exhaust Line, B F, represents the change in pressure that takes place when the exhaust-valve opens.

The Back-pressure Line, F J, shows the pressure against which the piston acts during its return stroke.

The Point of Compression, J, is the point where the exhaust-valve closes. It cannot be located definitely, as the change in pressure is at first due to the gradual opening of the value.

The Compression Curve, J K, shows the rise in pressure due to the compression of the steam remaining in the cylinder after the exhaust-valve has closed.

The horsepower of an engine is as we have seen

$$H.P = \frac{P\ L\ A\ N}{33000}$$

in which P is the mean effective pressure, L the length of stroke in ft., A the net area of the piston head in sq. in., N the number of strokes per min. It is seen that in order to accurately use the above formula we should really compute the horsepower in the crank end and head end separately, for the piston rod reduces the net area in the crank end and the mean effective pressure will in general be different in each end. When separate computations are made, then, we must consider N as the number of revolutions per minute and afterwards add together these two separate computations.

The mean effective pressure is the mean net pressure urging the piston forward and is equal to the mean height of the indicator card times the scale of the indicator spring. The mean height of the indicator card is obtained by computing the area enclosed in the card and then dividing by the extreme width of the card. The computation of this area involves difficulties and a separate lecture will be devoted to several methods accomplishing this result.

The student should consider this lecture largely as one of definitions. These should be thoroughly mastered in order to intelligently follow the succeeding lectures.

Thermotwisters.

1. By reading up cross references on the indicator, outline a series of rules of procedure in taking cards from the indicator.

2. Make a list of all the errors which frequently arise in the taking of indicator cards and devise cures or methods to avoid the same.

WATER POWER DEVELOPMENT.

During the latter part of the year just closed the Public Policy Committee of the American Institute of Electrical Engineers at a public hearing in Washington put before the U. S. National Waterways Commission a remarkable brief along the general lines of water power development.

The general cost data and figures on the extent of water and steam competitive development gathered in this paper is of intense interest to western power men. The men composing this committee add a stamp of reliability to this data that make it at once a new reference mark for American practise.

The Committee first sets forth the high scientific and professional ideals of the A. I. E. E., consequently it refrained from expressing itself on the commercial, industrial, legal or political aspects of the water power situation, except when these are incidental to the effect of that situation upon the practice of electrical engineering which it is the society's object to promote.

Relation of Water Power to Navigation.

The Committee further notes that the utilization of rivers and smaller streams for navigation and for the development of power are naturally inter-related is obvious. As regards by far the greater part of our undeveloped water powers on the public domain, the ultimate value as sources of power of those streams is vastly greater than any possible value which could be realized by attempts to utilize them as channels for navigation, but in the case of many of our larger rivers the possibilities of development for purposes of navigation predominate as compared with power development. The committee recognizes the fact that in all cases where practical possibilities of both navigation and power development exist the two objects in view are cooperative and not antagonistic—the construction of the dams and locks necessary to secure navigability affording a natural and generally effective means of developing the power of the streams.

Water Power a Public Utility.

Modern water power developments usually are not local private enterprises, as is generally supposed. The developments in recent years in the electrical transmission of power have made possible the distribution of electric power from a single water power plant over territories embracing in some cases over 40,000 square miles in area, supplying electric power for diversified purposes to hundreds of thousands of people. Such distribution of water power is an advantage to the consumers, and any policy tending to retard or handicap the development of water powers is a disadvantage to the people in the surrounding territory and retards its industrial development.

The regulation of public utilities by public service commissions has become practically an accepted principle in the United States, and there is no reason why safeguard from unfair charges for water power should not be found by this means, especially where the wide area covered by electrical distribution makes the public nature of a water power obvious.

Distribution of Investment in Hydroelectric Systems.

The investment of capital in hydroelectric systems is not confined to the dam and power house. In general, not over fifty per cent of the investment is represented in the generating plant, the balance representing the cost of the transmission lines radiating from the plant, the substations at the ends of the transmission lines for the conversion and distribution of the transmitted power, and the secondary distribution lines delivering power from the substations to the premises of the various consumers. The distribution system outside of the power plant, while not apparent to the casual observer of a power house and dam, represents in many hydroelectric developments the greater part of the total investment.

Close Competition Between Water Power and Steam Power.

The belief among certain classes of the public that water powers yield excessive or disproportionate profits springs primarily from two causes—the conception that the water itself is the power and that the expenses of operation of a water power are small while the company's income is large.

While, certainly, the power could not be developed without the water, the water on its part can deliver no power except by means of the dam, the power house, and its appurtenances. It is difficult for the public to regard these once built as invoving continuing expense, but they do. This expense is comparable in amount with the cost of coal in a steam station, and is the return due to the capital invested. It takes the form of interest, sinking fund expenditures, depreciation and taxes. The invested capital in a water power is so much greater than the public realizes, that with interest charges at not more than 5 or 6 per cent, in a majority of cases, from 70 to 80 per cent of a water power company's income is absorbed.

This return to capital is not profit. Without the prospect of it, capital cannot be secured.

Of a water power once built and after its expected market has been developed, the operating expenses, exclusive of the returns to capital, are seen by the public to be small, which they are, in a majority of cases, absorbing only from 15 to 20 per cent of a company's income. The remainder, however, that is left for profit after capital and operating charges are paid is usually not large, and certainly not excessive, especially when there is always risk of damage from floods, lightning, failure of expected market to develop, and such uncertainties of operation as the art of electrical engineering has not yet been able completely to remove.

Practically all water powers come to birth or not on the answer to the question "What is steam power in the territory costing?" and they can only live when they deliver power at a substantially lower cost. At the same cost, they remain unborn.

Besides the cost of power, the relative amount of investment is a determining factor. While at present a steam electric plant can be built for $75 per horsepower the cost of a hydroelectric plant varies from two to four times that amount. Part of this difference is because the steam plant can be built near the center of its market, while the water power is almost invariably at a distance.

With the capital required for a water power so much greater, the tendency is to build a steam plant.

even if the power it delivers is not as cheap as that of a water power. If it can be shown that water power can be delivered for, say, $25 per horsepower per year, but that steam power can be produced for, say, $27, the water power plant will not be built, and the steam power will. If, however, the water power could be delivered for $24, the difference might turn the tide in favor of the hydroelectric investment.

It is because of the great effect of slight differences in the cost of water power upon the determination of the question "Shall water or steam power be developed in a given community?" that even light burdens in the form of taxation, charges for sinking fund to wipe out the investment at the end of a limited period, or limitations as to tenure even though not immediately onerous, loom so large in settling it.

Attention is often called to the increasing cost of coal with an implication that the cost of steam power will rise, permitting hydroelectric companies to raise their rates and exact undue profits. The implication is not correct. It is true that the cost of coal is rising, but it is also true that steam engines and boilers are constantly being improved in efficiency, and that the art of producing power from steam is progressing at a rate so much more rapid than that at which the price of coal is rising that the cost of steam power is continually falling. Should a limit to this fall be reached, which is not yet in sight, gas and oil engines are making such constant reductions in the cost of power that there is no probability that water powers will be free from the controlling competition of other kinds of prime movers. It is safe, to say that extortionate rates in water power are highly improbable even if the principle of rate regulation by commission were not applicable to hydroelectric companies.

Construction Risk in Hydroelectric Development.

While hydroelectric engineering is tending toward more standard methods of construction, each individual development will present new problems in engineering with the inevitable construction risk connected therewith. During construction the works are constantly subject to serious damage by abnormal floods, and unexpected difficulties and physical conditions may arise whereby the cost of construction may be very materially increased beyond original expectations. Furthermore, after the power plant itself is satisfactorily completed the success of the enterprise is commonly dependent upon the industrial development of a large territory surrounding the power plant upon which it relies for its market for power. Such industrial growth can only be predicted on general principles, and may be subject to unexpected retardation due to industrial depression or other unforseen causes. Again, unexpected competition may develop from new and improved steam and other engines, all of which limit or defer the profits of the enterprise. On account of these engineering and operating risks and uncertainties capital which is invested in hydroelectric enterprises is entitled to reward commensurate with the risk.

Revocable or Limited Term Permit.

The revocable permit for the construction of a hydroelectric system does not attract capital because of the obvious uncertainties involved. In case of revocation, not only would the power plant and dam be forfeited, but all of the transmission lines, substations, and distribution system dependent thereon for their operation jeopardized. Not only is it difficult to induce capital to invest in such a development based upon a revocable permit, but it is very difficult to close the long term power contracts with consumers which are necessary to make a hydroelectric system financially successful. Consumers are unwilling to make their future business requiring power dependent upon a permit which might cause at any time the complete disorganization of the system supplying their power.

A limited term franchise also involves financial and engineering difficulties which seriously impede the normal development of a progressive hydroelectric system. Such systems are laid out from their inception for ultimate growth, and in this respect are comparable to large railway systems. The transmission lines are constantly reaching out into new territory in order to meet new demands, and with the development of the art it is necessary to make investments in extensions in order to maintain satisfactory service and to meet the demands of power consumers.

With a limited definite term beyond which renewal of rights are uncertain, no company would be willing to continue indefinitely the extension and improvement of a system so necessary and desirable from the standpoint of public service. The necessity of writing off not only the original cost of the plant, but the continual annual investment in additions thereto within the limited term of the permit requires an annual sinking fund that adds materially to the cost of the water power. This is a hardship, not only upon the power company, but upon the consumer.

Before the end of such limited permit development of the system would cease, maintenance expenses would be cut to a minimum, and the plant would deteriorate to a point where the service to the public would become unsatisfactory.

Interconnection of Contiguous Hydroelectric Systems.

It has been suggested that with the growth in extent of large hydroelectric distributing systems ultimate interconnections and combinations between them might establish a monopoly and permit the raising of prices for power.

Such interconnection between contiguous hydroelectric systems offers decided and important engineering advantages. It improves the constancy of electrical pressure and enables the system to draw power from two or more independent power plants.

The rain-fall occurring at different times on two or more separate watersheds are thus made to benefit all of the consumers on the combined systems.

Such interconnection also permits reduction in operating expenses and assures better service by reducing to a minimum the probability of total interruptions at any time from line troubles or otherwise.

The investment and consequently the cost of power can be reduced by combination, because less capacity in generating machinery to serve as spare plant for emergencies need be installed, and operating expenses can be reduced by rendering repairs easier, owing to greater facilities for shutting down for work or for inspection. Any tendency towards raising the price of power as an accompaniment of such combi-

nation is restrained automatically by competition with steam power, and can be regulated by government commission.

Extent of Water Power Development.

The statistics of water power collected under the direction of Congress several years ago and embodied in the Report of the National Conservation Commission of 1909, show that there is at present developed in the United States about five million horsepower of water power.

The amount of power produced by steam from coal is difficult to estimate, but is considered to be about 27,000,000 horsepower, and is rapidly increasing with attendant depletion of coal reserves. A large part of this it is not only possible but easy for water power to replace if it were made freely available through development. Within range of development at a cost of investment that would make the cost of such power about equal to that of steam power, there is still undeveloped in the streams of the United States about 35,000,000 horsepower.

Any action by Congress that would accelerate the release of this power would conserve enormous supplies of coal for such domestic and industrial purposes as only coal can supply.

VOLTAGES AND FREQUENCIES.

The latest standardization rules of the American Institute of Electrical Engineers give the following interesting data relative to current practice in voltages and frequencies:

Voltages.

Direct-Current Generators. In direct current, low voltage generators, the following average terminal voltages are in general use and are recommended:

125 volts. 250 volts 600 volts

Low-Voltage Circuits. In direct current low voltage circuits, the following terminal voltages are in general use and are recommended:

115 volts 230 volts 550 volts

In alternating-current low-voltage circuits, the following terminal voltages are in general use and are recommended:

110 volts 220 volts 440 volts 550 volts

Primary Distribution Circuits. In alternating current, constant potential, primary-distribution circuits, an average voltage of 2200 volts, with step-down transformer ratios 1 10 and 1 20, is in general use, and is recommended.

Transmission Circuits. In alternating-current constant potential transmission circuits, the following impressed voltages are recommended:

6,600 11,000 22,000 33,000 44,000 66,000 88,000 110,000

Transformer Ratio. It is recommended that the standard transformer ratios should be such as to transform between the standard voltages above named. The ratio will, therefore, usually be an exact multiple of 5 or 10 e.g., 2,200 to 11,000; 2 200 to 44,000.

Range in Voltage. In alternating-current generators, or generating systems, a range of terminal voltage should be provided from rated voltage at no load to 10 per cent in excess thereof, to cover drop in transmission. If a greater range than ten per cent is specified, the generator should be considered as special.

Frequencies.

In Alternating Current Circuits, the following frequencies are standard:

25 cycles 60 cycles

These frequencies are already in extensive use and it is deemed advisable to adhere to them as closely as possible.

TO PREVENT THEFT OF CURRENT.

To prevent the theft of current by closing the meter loop, the Seattle Electric Company disconnects the service wire at the pole where there is a single customer on one service. In apartment houses where one service feeds two or more customers and the meter boxes are not in a meter room where they can be observed every month by the regular meter readers, the services are sealed into a service block on which is posted a warning against the theft of current. In this warning is printed the State law regarding the theft of current and the penalty provided in case of conviction.

Quite a number of persons have been caught stealing current by means of a jumper, and, in such cases where proper evidence can be obtained, a criminal prosecution has been brought, and, after conviction, as much publicity has been given to it as possible through the daily papers. Where the company does not consider the evidence sufficient to obtain a conviction, a settlement is made for the unrecorded service.

The law, as passed by the 1909 Legislature of the State of Washington, is not satisfactory to the operating companies. As it is interpreted by the legal department of the corporations and by the prosecuting attorney of King County, the law only covers a case where a meter is installed. A party may connect to the pole line and take current if there is no meter in the premises and not come under the provisions of the law.

COLD WEATHER DAMAGE AT PORTLAND.

During the past week an unusually cold spell with much ice and snow, followed by a sudden thaw with resulting floods, has greatly crippled the public utility companies at Portland and vicinity. The telephone companies were the greatest sufferers from the cold weather and the railways from the floods.

More than 1500 miles of telephone wires were put out of commission and hundreds of poles toppled in the streets, being either torn from the ground or broken by the weight of the ice-covered wires. At Portland over 5000 telephones were reported out of service and much damage was also done to the long distance lines.

Parts of the town were in darkness for several nights because of the danger of turning current into the tangled network of wires, but by strenuous efforts electric railway service was maintained. The Portland Railway, Light & Power Company did all in their power to assist the telephone companies in their work of line repairs.

FISHER ON WATER POWERS.

In his annual report, Walter L. Fisher, Secretary of the Interior, advocates that the Government retain title to water-power sites on the public domain and supervise water powers on the navigable streams, at the same time granting to the States the right to determine the terms and conditions upon which water powers shall be developed within their borders. While he [illegible] the receipts from water-power privileges [illegible] the Federal treasury, he would have such funds expended for public works in the States where the funds originate.

PUBLICITY AND ELECTRICITY.[1]

BY A. H. HALLORAN.

Publicity is like electricity, not merely in spelling, but in character,—each a strong force with great power to do work. Publicity, as a force, acts on the brain. Its power is to move the mind. Its work is to create confidence, induce, interest, develop desire and bring buyers, the four concomitants of successful salesmanship, for as you advertise so shall you sell.

Advertising is of two kinds, profitable and unprofitable. We shall consider only the former, which has five essentials,—intensity, quantity, frequency, forcefulness and distribution. The first two determine the potential energy, the third the power, and the last two the kinetic energy of publicity.

Energy is equal to the product of intensity and quantity. Thus electrical energy is voltage times current; hydraulic, head times volume; heat, temperature times entropy; publicity, intensity times quantity. Quantity of publicity depends upon the amount of space used and the number of readers. Intensity depends upon the class of readers. Three amperes at 220 volts will do more work than five amperes at 110 volts; three thousand buyers who are interested are worth more to you than fifty thousand general readers. Intensity or quality of circulation is even more important than quantity in determining the potential energy of publicity.

Power is equal to energy divided by time. This element of time or frequency, is particuarly important in estimating the power of publicity. A small current flowing for a long time will finally deposit a heavy plating of electrolytic copper, just as slight publicity, appearing for a long time will eventually induce interest. But equal energy experted in less time will bring buyers more quickly; it has more power to move the mind on account of its greater frequency. This illustrates the reason for the greater power of a daily or weekly, as compared with a monthly or quarterly. Buyers forget; frequency reminds.

Kinetic energy is measured by the product of force and distance. The work of an electric motor is its torque or turning force times the distance through which it moves the load. The work of publicity depends upon the force of the advertising copy and the distance or extent of its circulation.

The problem of profitable publicity is thus reduced to two factors, advertising copy and advertising medium, what to say and to whom to say it.

Copy bears the same relation to publicity as does magnetism to electricity,—if strong it attracts attention, holds interest and pulls purchasers, if weak it nullifies the good effects of large space or extensive circulation. Good copy is consequently the first requisite for profitable publicity

Mediums for producing publicity are as various as those for generating electricity. The old town-crier beat a drum to get public attention, the old scientist beat a cat-skin to get electricity. Such crude methods were long ago replaced by more efficient means, circular letters, catalogues, bill-boards, street-cars, electric signs and newspapers, the last-named being the most efficient as a generator of publicity just as the [illegible] is the best generator of electricity.

The nicety with which both the newspaper or magazine and the dynamo or generator conform to the five essentials of profitable publicity, as already developed, is most remarkable. The electromotive force of a generator varies with the product of field intensity, frequency of rotation and number and arrangement of conductors, and is entirely dependent upon the force of its prime mover. The publicity force of a magazine likewise depends upon the intensity of its field of circulation, frequency of issue and extent and number of subscribers, and also upon the force of the advertiser's copy.

Time does not permit the elaboration of more than one other of the surprising features of the likeness between publicity and electricity. Analogy is a powerful tool if used with care, but it should be remembered that a comparison is a concession, usually given to supply a lack of technical knowledge and is to that extent misleading. Analogy is an aid to understanding but not a substitute for it. Electricity is transmitted at high voltage through long transmission lines and distributed at lower voltages to the ultimate consumer. In journalism the technical journal corresponds to the high tension transmission line and the newspapers and popular magazines to the distributing system. As the constitution states, this the Electrical Development League has been formed to "educate consumers in the application of electric current to their needs" we should adopt the most efficient means thereof, that of newspaper advertising.

Some of you who have tried it say that advertising does not pay. Why? If in a San Francisco newspaper there can be no question of quantity of circulation or even of quality for every newspaper reader is or should be an electricity user. Many of you have used large space and the distribution is throughout the territory in which you sell. So of our five essentials for profitable publicity there remain only the factors of frequency and forcefulness. Your advertising has been spasmodic, infrequent, and some of your copy has lacked force.

This organization has the means and the talent to obviate these mistakes and to conduct a great campaign of public education about the manifold advantages of electricity. When Mr. Philip Dodd was here he told of the success of the "Peoples Electrical Page" at Cleveland and the other large Eastern cities. Why should we not adopt a similar plan. This page is made up of advertisements of electrical concerns and popular reading matter devoted exclusively to interesting items about electricity. The reading matter is financially supported by the small display advertisements of the local contractors, supply dealers, manufacturers and electric companies.

As a starter your committee suggests that you use a page in one or two of the San Francisco newspapers once a week. By contracting for this large space to be used in the course of a year the members of the league can get a lower rate than if they signed individual contracts. A small advertiser also gets proportionately more for his money.

The details of the advertising contracts will be handled by the advertising department of each paper, so that the Publicity Committee will have nothing to do with the soliciting, billing, copy preparation, etc.,

[1] [illegible] Electrical Development League, San Fran[illegible] [illegible] 8, 1912.

but will merely supervise or furnish the reading matter. This must be worded so as to appeal to the housewife and possible user of electricity and upon its excellence depends the success of the page. To put the average reader in a receptive frame of mind and make him familiar with electricity it must be newsy and readable, free from technicalities and imbued with human interest.

Thus it is possible to create confidence in the central station, induce interest in the electrical wiring of the home, develop desire for electrical conveniences and bring buyers to all of you.

PINCHOT OPPOSES PIPE LINE.

Gifford Pinchot, former chief forester, and president of the National Conservation Association, is urging the defeat in Congress of a bill introduced by Representative Raker of California, granting a water pipe line right of way through the Mono national forest to the Hydroelectric Company of California.

Mr. Pinchot declares that while the money value involved is insignificant, the bill is dangerous as "directly in the interest of water power grabbers," and would establish the right of water power companies generally to use national forest lands in spite of the government and the courts.

Without government permission, Mr. Pinchot says, the company dug a ditch and began to construct a line 3800 feet long through the Mono forest and [illegible] was stopped by a government injunction.

The company then applied to the Department of Agriculture for a permit to lay the [illegible] the department permitted the work to go on [illegible] the terms of the permit were being prepared. One of the stipulations was that the company [illegible] for the use of the right of way and that the permit [illegible] be revocable. The company refused to agree to the stipulation and the temporary permission was revoked.

In reply to Pinchot's statement, Representative Raker declares that his bill for the relief of the Hydroelectric Company "is not in the interest of the water power grabbers." "The purpose of the bill and its only effect will be to clear away any legal doubt as to the company's right to the continued maintenance of its pipe lines."

Raker denied that there had been any haste or concealment in the legislation which has been pending six months. The company, he asserts, has been generating electric power for its own uses in mining and for the towns of Bodie, Aurora, Lucky Boy and Wonder for illuminating purposes.

"The company's pipe line crosses land claimed under mining laws over which a forest reserve has been extended from an original forest ten miles away. The lands are admittedly incapable of forestation."

The easement for the line is claimed under mining laws, and under the act granting rights of way across forest reserves for mining and municipal purposes.

SOUTH AMERICAN OIL DEVELOPMENT.

A company capitalized at $330,000 has been organized to develop the oil fields in the vicinity of Punta Arenas, in the extreme southern part of Chile, and American boring machinery is arriving for the fields south of Concepcion.

HINTS ON METER INSTALLATION.

A paper delivered by R. E. Thatcher before the Spokane meeting of the Northwest Electric Light & Power Association contains some valuable pointers on meter installation.

The exercise of great care in the installation of meters has much to do with their accuracy. It is seldom good policy to install meters of a capacity equal to the full connected load, especially for lighting loads. Meters are all rated so that they will carry a 50 per

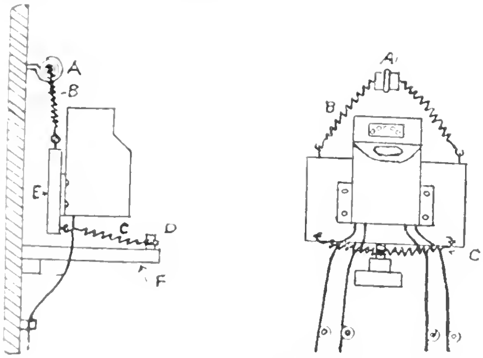


Fig. 1. Meter Spring Board.
A—Screw Hook and Knob
B—No. 4 Screen Door Spring
C—No. 2 Screen Door Spring
D—Screw [illegible] Knob
E—2" 12"x12" Spruce
F—2"x4"

[illegible] several hours a day without injury [illegible] exceptional cases, such as saloons, cafes [illegible], that the full connected load is on [illegible]. A meter in a large office building or [illegible] of a capacity equal to the connected load will under register on the long hour hall [illegible]. The maximum load on such installation is seldom [illegible] than an hour per day, so that a meter [illegible] of 60 per cent of the max load will [illegible] and will give a better registration during [illegible]. In residences there will seldom be [illegible] more than 30 per cent of the connected load [illegible] should be metered accordingly. [illegible] smaller than 5 ampere meters are [illegible] occasionally burn out [illegible] cover meter.

[illegible] there should be no place in a build[illegible] vibration, especially in the [illegible] vibration tends to has[illegible], and, in commutator [illegible] sparking at the brushes, both [illegible] down very rapidly. [illegible] provided which [illegible] the meter should be in[illegible] on a springboard. A [illegible] springboard is shown in [illegible]

[illegible] affected consid[illegible] therefore essentials [illegible] from wires carry[illegible] more notice[illegible] the larger size [illegible] load in wires if [illegible]

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Canal Rebates

Since the agitation over the violations of the Sherman anti-trust law has taken place, the mention of the word "rebate" seems in the eyes of the general public to present expressions of holy horror. Unconsciously this feeling is shown in the consideration of affairs pertaining to the traffic conditions for the Panama Canal.

The daily press is filled with discussions of canal rates, ship subsidies and all other items of burning interest connected with the early opening of the great inter-ocean project. Even in the last few days announcement has been made that the Spreckels interests in San Francisco are seriously considering resuming the trans-Pacific traffic to Australia abandoned by them some time back.

American sentiment is undoubtedly overwhelmingly in favor of giving our ships the best of it as opposed to those of foreign charter. Yet if the mention of the word "rebate" is made during the discussion, the nasal protrusions of the listeners become at once upwardly extended as if another whale had been blown ashore at Santa Monica and those present had been ten days late in viewing it.

Be this as it may. The Pacific Coast sentiment demands that there be free tolls for our inter coast ships whether it be called "rebate" or not.

Clearness

The constant echoes of court decisions relative to interpretations of specifications forces upon us all the conviction that an essential element is lacking in many of our documents covering engineering contracts, and that this lacking element is clearness. Few of our engineers are capable of writing a clear, one-meaning specification, and often in desperation the lawyer with his automatically oiled tongue is invited in to express in no uncertain terms, if possible, the meaning desired. When the document is complete, and those of us of average intelligence endeavor to decipher its true meaning, the impression left upon our mind when the task is finally finished is that of a terrific but mis-spent blasting in an underground working. We enter in, candle in hand, to examine the result, but when through the murky air we peer at the side walls, we find the mother-lode still unpierced, its treasure-laden rock still unfathomed.

Often times lack of clearness can be avoided by the engineer himself paying attention to the most elementary rules of composition. In the first place the engineer should study not what effect his own words produce upon himself, but after forming in his own mind a clear picture of the thoughts he desires to represent, he should stop and analyze the effect his few chosen words will produce on the other party to the contract.

Above everything else simple one-meaning words should be used. Two common faults arise in the improper use of words—either they are vague and ambiguous in their meaning, or else so obscure as not to mean anything at all. Vagueness usually arises from a cloudy idea in the engineer's own thoughts as to the meaning of the particular word, while ambiguity is a defect in the word itself. By all means,

then, the engineer should avoid using any word having more than one interpretation. If it is absolutely necessary to use such a word it should be done in such a way as to convey but one possible construction.

Obscurity, on the other hand, is the fault, pure and simple, of the supposed master mind drawing up the specification. With no definite, specific idea in view how can we convey a definite, specific one-meaning idea to another? Where a perfectly soldered union is desired between two wires, we sand paper off the connectors until nothing but bright polished material glistens before our eyes. Then we apply the solder. What visions of pure, unadulterated, one meaning specifications would result if the engineer, when laying the basis for a binding contract or performing the mechanical process of linking ideas together, first polished up the mental tissue within.

The master mind should weigh with delicacy the definite, one-meaning words to bind the contract. By cutting out a superlative word here, an ambiguous clause there, opening up a clearer meaning with the new word, strengthening the entire fabrication by applying simple rules of unity and coherence, the master mind of the engineer, with these many fingered mechanisms should convey an even, clear flow of expression with the ease with which the governor of a power installation maintains its steady load.

Definite Irrigtion Costs

Our Western arid empire, like the mummy, has passed through five thousand years without a smile. But now the rapid advance and investigation of reclamation projects in the West have certainly caused many to marvel at the possibilities of this substantial asset of our country. The engineer after months of deep study has become convinced and the investor, after periods of trial and investigation, has proved to himself the wholesome nature of such investments.

The first thing that impresses a new comer, as he spins his way across the continent through miles of howling waste, is the apparent worthlessness of the country "which God forgot." When, however, the swiftly moving overland limited speeds its way into a district made to blossom with scientific irrigation, how soon his ideas are changed and his conviction formulated. Upon inquiry he finds that the arid lands can be purchased for from \$2 to \$10 an acre, while those under irrigation can not be purchased for less than \$150 an acre, and may even, under extreme conditions necessitate cold cash to the amount of \$4500 per acre to tempt the owner. Such conditions as these cause serious-minded men to reflect and ruminate upon what it all means. In the West acreages by the millions are to be found of this arid nature, awaiting but the scientific application of water to make them equally prosperous as the most productive yet reclaimed.

Seeing these apparently divergent valuations, representing say \$10 an acre on the one hand and \$100 on the other, has led the "wild catter" to occasionally put one over on the public. Projects, unsound to the investor and impossible from an engineering standpoint, have at times been lauded to the sky and the hard-working Easterner inveighled into ruthlessly investing his money. The thousands of happy and prosperous settlers, however, testify with their merry voices re-echoing on the cool snappy morning air, the deep meaning it all has for the upbuilding of our natural wealth. The idea of reclamation as a whole is substantial, is profitable, is working out untold possibilities for the commercial wealth and prosperity of our nation.

It has been hard in the past to get definite data, definite proof by actual test, of costs pertaining to scientific reclamation. Engineers have estimated and unseen factors have arisen necessitating in the majority of cases, an outlay of cash often double that which was reported upon. The consequence has been that the confidence of many has been shattered in such projects as these.

Elsewhere in these columns will be found, however, the costs, not only of installation, but actual operation of a project covering 48,000 acres of arid land. This project represents the class of problems before the reclamation engineer of the future. The culmination of gravity systems of irrigation in the West has practically been exhausted. Utilization of our numerous water powers is the solution of the problem for the future.

A few years back pumping water 66 feet to irrigate 48,000 acres of land would have been regarded as grossly impracticable. The remarkable thing about this government project known as the Minidoka, is the several unusual features. In the first place, it has been found that during the past year the actual cost of energy, including depreciation, amounted to only a trifle over a quarter of a cent per kilowatt-hour. Assuming this project on the basis of a private enterprise, interest, taxes and profit would necessitate say 10 per cent on the investment. On this basis power could be had at the remarkably low figure of only .6 cent per kilowatt-hour.

Considering it from the other standpoint for a minute, namely that of a project creating natural wealth for our country, we find that an outlay of but \$19 per acre has been necessary to reclaim this 48,000 acres of land, thereby making its value per acre enormously above the actual outlay necessitated. Again the cost per acre of supplying this pumped water for irrigation amounts to but \$1.40 per acre, including depreciation. Assuming this again as a private enterprise, returning to the investor 10 per cent on the investment, the cost per acre per year to supply the water totals up but \$3.30. When we consider such remarkable facts as these, well [illegible] can we wonder where the enormous outlays of [illegible] will be diverted in the future, and question [illegible] as to whether the financial return will be sufficient to warrant the investor for his outlay.

Many look upon an investment in agricultural lands in the West, not as a money making proposition, but as affording pleasure and enjoyment. In a word a place where rest, quiet and health may be acquired if [illegible]. The final value of all lands in general [illegible] such a value as the annual net return [illegible] would represent as a reasonable rate of interest on this value.

PERSONALS.

Chas. C. Moore is at Washington, D. C.

Frank B. Kierulff, Jr., of Los Angeles, was at San Francisco during the past week.

W. D. Barkhuff, district engineer of Seattle, has been appointed city engineer at Everett, Wash.

F. B. Gleason, manager of the Western Electric Company's San Francisco branch, is at Los Angeles.

E. B. Strong and Robert Sibley, of the Journal of Electricity, Power and Gas, were at Los Angeles this week.

C. A. Tupper is again at the Milwaukee works of the Allis-Chalmers Company, where he is doing some special work.

W. B. Lewis, of the Western Electric Company's Pacific Coast sales force, is visiting the various Eastern factories of the company.

Henry J. Hinde, vice-president and general manager of the Toledo Machine & Tool Company, of Toledo, Ohio, is at San Francisco.

J. C. Kirkpatrick, president of the National Pole Company, of Escanaba, Mich., is at San Francisco on a visit of the Pacific Coast.

R. D. Holabird, president of the Holabird-Reynolds Company, is visiting his Seattle branch house, and will spend two weeks in the Northwest.

E. V. Smith, of the Eccles & Smith Company, who recently returned from an Eastern trip, is visiting the Portland branch of this railway supply house.

G. L. Parker, of the United States Geological Survey, is investigating all streams of the Cascades with a view of securing data on water power.

Frederick S. Myrtle, a well-known newspaper writer, has been appointed director of publicity for the Pacific Gas & Electric Company, at San Francisco.

Charles S. Lee, who was formerly connected with the hydrographic department of the Los Angeles Aqueduct project is now in their power department.

H. V. Carter, president of the Pacific States Electric Company, is at Los Angeles and will probably visit the company's branch house in Arizona before returning.

C. F. Conn, assistant manager of J. G. White & Company's Pacific Coast branch office, has just returned to San Francisco, after spending several weeks at New York.

Herbert Fleishhacker, one of the vice-presidents of the Great Western Power Company, is visiting Klamath Falls and other points in Central Oregon, where he has investments.

Delos A. Chappell, president of the Southern Sierras Power Company, which is constructing a power transmission line from Bishop Creek to San Bernardino, is at San Francisco.

T. C. Gregory, president of the Vallejo and Northern Electric Railway, has been visiting Sacramento and Vallejo in connection with the bids for terminal work in the latter city, which have just been opened at San Francisco.

A. L. Searles, manager of the rock drill department of the Fort Wayne Electric Works, of the General Electric Company, is at Portland, Oregon, and will visit the Northwest before his return to Madison, Wis.

Harry Woodward, who was formerly the industrial man with the City Electric Company, is now division manager of the Great Western Power Company's Ookland Division, which comprises Alameda and Contra Costa counties.

Thomas Mirk, of the firm of Hunt, Mirk & Co., is in Oregon on engineering business. K. G. Dunn, electrical engineer with the same firm, is at San Diego in connection with new work that is being started for the San Diego Electric Railway Company.

F. G. Cottrell, formerly professor of physical chemistry in University of California, and now an expert in the employ of the Federal Bureau of Mines, has given the Smithsonian Institution the patent rights in the process for the electrical precipitation of smelter fume which bears his name.

James S. Cain, who is one of the principal shareholders of the Pacific Power Company, and of the Southern Sierras Power Company, is at San Francisco from Bodie, Cal. A Southern California office for the above companies will be established at Fifth and Spring streets, Los Angeles.

W. A. Brackenridge, formerly of the Niagara Falls Power Company, and now general manager of the Southern California Edison Company of Los Angeles, is at San Francisco confering with representatives of the Harris Savings Bank and Trust Company, of Chicago, and their associates, Harris, Forbes & Company, of New York.

John Martin is in the East on business connected with the early construction of a 124-mile natural gas pipe line from the Midway field to Los Angeles, by the Midway Gas Company, of which he is president, and Cyrus Pierce, secretary. It is announced that $600,000 worth of 12-inch wrought iron pipe has just been purchased from the National Tube Company through J. G. White & Company, who will construct the pipe line.

J. H. Wise, assistant general manager of the Pacific Gas and Electric Company, J. P. Jollyman, electrical engineer, and H. C. Vensano, civil engineer, have returned to San Francisco after an inspection of important new substation work in progress at Thorton Station, on the Western Pacific, between Sacramento and Stockton. The new supply and distributing station, with a capacity of 20,000 kilowatts, was designed by Vensano for stepping down 60,000-volt current to 11,000 volts for distribution through irrigation districts. More than 20 miles of high-tension branch line has been constructed, and many miles of low-tension distributing lines will be required in the new territory.

ELECTRICAL DEVELOPMENT LEAGUE.

The Electrical Development League held its regular monthly luncheon at Tait's, San Francisco, on January 9, with a large attendance of members and visitors. Among the latter were Frank B. Kierulff Jr. of Los Angeles and Ray D. Lillibridge of New York City, as well as several representatives of the press. Mr. Lillibridge and Philip Dodd of Cleveland were elected honorary members of the organization.

Reports of progress were received from the various committees and a paper on "Publicity and Electricity" was read by A. H. Halloran. W. W. Briggs, chairman of the entertainment committee, announced that a debate would be held at the February 6th meeting on the question, "Resolved, That the central stations should sell lamps." The place of this meeting will be announced later.

ELECTRICAL CONTRACTORS' NOTES.

Frank Somers, manager of the Century Electric Company, of San Jose, was a recent San Francisco visitor.

E. B. Bogle, of the Bogle Electric Works, of San Rafael, was at San Francisco during the past week.

H. Jacobs, an electrical contractor of Santa Rosa, is among the recent arrivals at San Francisco.

Although the number of building contracts filed since the first of the year has not been large, there is an excellent outlook for building work that will carry with it many good electrical wiring contracts. A number of good buildings are coming right along.

Hetty Bros. have been awarded a wiring contract for a one-hundred-room hotel which is owned by the George Burnett Estate, on the north side of Market street, between McAllister street and Marshall Square.

J. Bachman has been awarded a wiring contract for an apartment house on the corner of California and Webb streets, at $2079. Several other local contractors figured the same job, but all of their figures were above $3000.

INDUSTRIAL

NEW INVERTED LUMINOUS ARC LAMPS OF HIGH ILLUMINATING EFFICIENCY.

Seventy-six inverted luminous arc lamps of a new type were turned on in New Haven on the evening of December 15th, flooding Church and Chapel streets with white light and making New Haven, a city with a real white way.

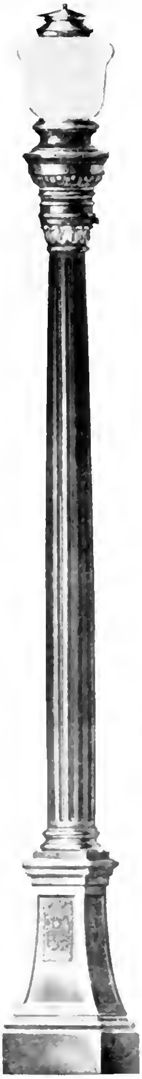
The lamps installed at New Haven are inverted series luminous arc lamps combining high illuminating efficiency with adaptability to ornamental lighting and are manufactured by the General Electric Company, Schenectady, N. Y.

The lamp casing constitutes the capital of the supporting post or column and is so designed that by releasing a latch it may be lowered to give free access to the lamp mechanism as readily as the similar operation is accomplished on an ordinary arc lamp.

Within the base of the pole an absolute cutout is placed so that the trimmer may disconnect the lamp from the line before starting to work on it.

In operation and design the mechanism is essentially the same as that of the standard mechanism of the direct current series luminous arc lamp of which more than 75,000 are now in operation. The arc is struck between a stationary non-consumable copper upper electrode and a movable magnetite lower electrode burning under normal updraft conditions. A single side rod supports and carries the electrode, fume d me and chimney.

The lamp is equipped with a diffusing globe that is unique in design in that it is perfectly filled with light and no circular shadows are cast upon it by the electrodes. The globe may be removed without disturbing the alignment of the electrodes. A large ash pan is provided which is easily removable. By using the new specially designed diffusing opal globe which furnishes a beautiful secondary source of pearl white light of high efficiency and low intrinsic brilliancy, it is possible to place the lamps at the extremely low height of 11½ feet without producing a glare.

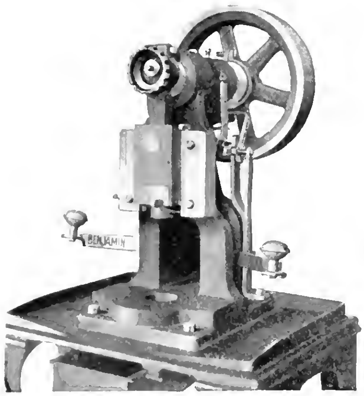


Inverted Luminous Arc Lamp

THE BENJAMIN SAFETY DEVICE FOR STAMPING PRESSES.

The Benjamin Safety Device for Stamping Presses is intended to protect the hands of the operator of stamping presses, by necessitating removal of both hands from the point of danger to trip the press before the ram starts in its downward direction. The release of either hand permits the trip to return to its normal position, thus making it impossible for the press to repeat unless both hands are kept on the levers until the repeat operation is begun, in which event the operator would not have time to get his hands back into danger before the operation is completed.

The device consists of an operating lever normally inoperative, although free to move downward. This lever is made operative by the action of an electric retaining magnet through a circuit closer located on the opposite side of the press. Consequently, the press cannot be tripped by the operating lever unless the circuit through the magnet is first closed and retained closed until after the press has been tripped.



Benjamin Safety Device for Stamping Presses.

In addition to the protective feature, the use of the device results in an increased output of work where it is necessary to bring the hand into a position of danger for handling individual pieces. The operator knows that the press cannot trip until both hands are removed. The increased confidence thus created materially increases the number of operations actually performed, with a corresponding increase in the amount of work done.

This safety device can easily be adapted to all the standard presses. No drilling of holes is necessary. The magnets are wound for 110-volt direct current, but can be used on 220 volt direct circuits by use of suitable resistance in series, or be equipped for a.c. circuits. For demonstrating purposes the Benjamin Electric Mfg. Company will furnish a sample on thirty days' trial.

ELECTRICALLY HEATED SAMOVAR.

It is conceded by all drinkers of tea, that it is best prepared in a samovar, which is to the preparation of tea what the percolator is to the preparation of coffee. The word samovar is of Russian origin and designates the metal urn used in Russia for making tea, being filled with water which is heated by charcoal placed in a pipe with chimney attached, which passes through the urn.

It was but following the natural trend of the times to substitute an electric immersion type heater for the charcoal and chimney, and the result is the electrically heated samovar.

In addition to making the best quality of tea, the samovar also possesses an additional advantage in that it is possible by its use to make the tea on the table just where it is needed, and the tea therefore can be served at the desired temperature.

The samovar consists of a stand, urn, spacing ring, tray and cover, all formed from heavy sheet copper. The tea-

ball, which opens to receive the tea and which hangs from the lowering and raising chain, is of perforated and tinned sheet copper. The tea-urn can be readily removed from the stand for cleaning as it is attached thereto with a three-point bayonet joint.

The heater of the Westinghouse cylindrical immersion type is supplied. Inasmuch as the active portion of this heater is wholly submerged in the liquid in the tea-urn, all of the heat developed in the heater passes into the liquid. It is due to this feature that the device is exceptionally efficient and economical. The heating element is hermetically sealed within the copper jacket of the heater and is in intimate contact with, but insulated from, the walls thereof.

Electrically Heated Samover.

The construction effectively protects against oxidization of the heating element. The heater can be used for heating liquids in any vessel that will contain it and is sold separately. A silk-covered cord, a control switch and a separable attachment plug are furnished as a part of each heater.

One heat only has been arranged for in the tea samovar. This will raise water in the urn rapidly to the boiling temperature, at which tea should be made and the circuit can then be disconnected.

A single pole telescopic switch that is always cool is inserted in the cord, conveniently close to the samovar, by which the circuit may be opened or closed. The metal parts may be finished in either nickel or polished copper, while the handles have a rich ebony finish.

DEVELOPMENT OF POWER APPARATUS DURING 1911 BY THE WESTERN ELECTRIC COMPANY.

During the past year the line of Western Electric power apparatus has been completed so that practically all requirements are now met with standard machines, most of which are carried in stock.

Special efforts have been directed towards smaller machines, many of which are used in household applications on sewing machines, vacuum cleaners, washing machines, buffing and grinding outfits, etc.

A line of complete lighting and power equipments is now offered for farm and country homes, including generators, switchboards and storage batteries. These are comparatively simple to operate, and installations in various places have met with gratifying success. Switchboards especially adapted for small isolated plants have been brought out to meet all requirements.

A new line of long-life, enclosed flaming arc lamps of from 100 to 120 hours' life on one trim has been developed and represents a long step in arc lamp design.

In the Western Electric line of power apparatus are now included numerous ratings of two and three wire engine type direct-current generators, direct current belted motors and generators, special variable speed motors, elevator motors, crane and hoisting motors, mill type motors, steam driven direct connected generating sets, gas engine generators, special thirty-two and fifty-volt generators, electrolytic generators, engine-driven alternators, belt-driven alternators, water-wheel alternators, single-phase induction motors, single-phase repulsion motors, squirrel cage induction motors, phase-wound induction motors with both external and internal controlling resistances, variable speed induction motors, mill type induction motors, transformers, motor generators, exhaust fans, portable electric breast drills, sewing machine motors, grinding and buffing motors, printing press motors, motor-driven pumps, electric hoists, switchboards, arc lamps and mercury arc rectifiers.

CO-OPERATION IN THE ELECTRICAL INDUSTRY.

T. C. Martin, secretary of the National Electric Light Association, in a recent address on "Co-operation in the Electrical Industry" before the New York Jovian Club, emphasized the fact that the central stations had at last realized that the sale of electric current to the public was a "commercial" industry, and though while the big men of the industry realized that their entire business depends on the service which they give to the public, and that they must continue to bend their energies towards more efficient service, they have been spending entirely too much time and thought on the purely technical side of the business and the big important factor which they were facing and must face was the fact that they were public service corporations, and that as such their existence and success needed closer co-operation directly with the public. To achieve this co-operation they must not only adopt policies that would bring them into closer touch with the public, but must in every way co-operate and get in closer touch with the contractors and jobbers as distributors and with the manufacturers of current consuming devices, etc., which were supplied to the public, and by this closer co-operation could avail themselves of the increased confidence which would come from such co-operative methods.

He mentioned that the earnings in the lighting, heating and power companies of this country were over $375,000,000, and that the public would pay this year something over $1,800,000,000 for all electrical service, thus bringing out forceably the fact that as it was the public which the central stations must depend on for their existence and success and even for the legislation which effected them, that the public service corporations must have the support of the public, and must be in the confidence of the public, and that the public must be in theirs, and that they had reached that stage in the industry where all must work together for the common good.

Mr. Martin suggested that there must be some way in which the N. E. L. A. and the Sons of Jove could work together for the benefit of the industry as a whole and that possibly the way might be through the various local organizations in the different parts of the country, taking up definite practical lines of work for the benefit of the industry in the city in which they were located. He spoke of the harmony which the various luncheon clubs engendered among their members, and of the possibilities for practical co-operative development work which this harmony made possible.

He spoke of the far-reaching educational work which the N. E. L. A. is doing along general lines, along educational lines and through the Commercial Section, along commercial lines, and when it is remembered that the work now is reaching in an educational way not only the officers, but a great proportion of the employees in over 1000 of the lighting companies, and that this thousand constituted nearly 90 per cent of the earning power of the lighting companies of the country, he showed very clearly what an enormous factor the association is to the industry and how vital and important its work is.

The membership of the N. E. L. A. is growing—growing fast—and as the work grows with it, it increases more and more the efficiency of the men who are interested in its effi-

ciency both as concerning the electrical industry and the efficiency of the men as citizens. Emphasizing most emphatically that it was as citizens of the community that the public service corporation must work and using as an illustration a statement made by Mr. Carnegie some years ago, that it was not the factory, not the machinery, not the smokestack, that gave the service, but the men of the organization, and that were he to lose by fire or in any other way his various enormous mills and factories, the loss would entail but little time and some expense; but were he to lose the men of his organization—the support and personnel of these organizations—then surely would the entire business be ruined.

Altogether, Mr. Martin's talk was one of the strongest pleas which the electrical industry has ever heard for co-operation—practical aggressive co-operation which would unite central station companies, contractors, jobbers, manufacturers and the public into one great movement, for not only the development of the electrical industry, but for the human race.

LIFTING MAGNETS FOR HANDLING PIPE.

The magnet familiar to the majority is of the large size (43, 52 or 62 in.) for use in the large plant for handling immense quantities of pig iron, etc. It is usually assumed that a magnet cannot be employed efficiently in the small or medium sized plant. There are, however, many interesting uses of smaller magnets of special type. Sheet metal, piping, etc., can be handled by magnets of proper design.

Magnets Unloading Carload of Steel Pipe.

At the Chicago plant of the Rockwood Sprinkler Company two small 18-inch Cutler-Hammer magnets have been recently installed and have proven a valuable part of the well equiped plant. The Rockwood Company designs and assembles sprinkler fire protective systems at his plant. These parts are shipped in "knock-down" form to be set up by construction gangs.

Magnet Storing Steel Pipe.

In the illustration (Fig. 1) the magnets are shown unloading a carload of steel pipe, the trolley track extending over the railroad spur. From the cars the pipe is carried by the magents into the storage house (Fig. 2) and deposited in compartments, according to size, ½-inch to 10-inch pipe being used. The crane operator, alone, can do this work and as all the transporting is done from overhead, no floor space is needed for trucking and there is no interference with other work. The magnets operate steadily and noiselessly, accomplishing their work in quick time. Sprinkler equipments ready for shipment are also loaded by the aid of the magnets. The current taken by small magnets of this type is less than that required by the household electric iron. The consumption of current for each of the 18-inch magnets used in this plant is 1.9 amperes at 220 volts.

TRADE NOTES.

The General Electric Company has sold to the San Diego Electric Railway Company twenty-four G. E. 203, 2-motor car equipments, with K. 36-H controllers, and 24 straight-air brake contractor equipments. Also 24 straight air brake equipments and 24 slate switch panels and 24 slate relay panels. Also 48 Form D luminous arc headlights.

The Pelton Water Wheel Company has sold to the Thousand Springs Power Company, for installation at the plant near Wendell, Idaho, two 1500-h.p. Pelton-Francis turbines, each of which will be direct-connected to a Westinghouse generator operating at 600 r.p.m. Pelton oil-pressure governors will furnish the regulation. A peculiarity of this installation is the very short pipe line, which is less than 300 feet in length and 42 inches in diameter, conducting water from an immense spring on the rock ledge direct to the water wheels. The plant, which is backed by Lafayette Hanchett of the National Copper Bank of Salt Lake City, will feed into a transmission line that supplies electric power for both mining and irrigation purposes.

The Habirshaw Wire Company have just completed some submarine cable which is so out of the ordinary as to be of great interest. It is four lengths—800 feet each—of three conductor 350,000 C. M. 37 strands, each conductor insulated with 13/64 in. wall of 30 per cent Para compound, taped, the three conductors laid up in clover leaf form with fillers, tape, 11/64 in. rubber jacket of 30 per cent Para, tape, 1/8 in. lead, jute bedding, armored with 38 No. 4 B. W. G. galvanized steel wires and covered with two layers of jute and tar. The cable is to run under 13,000 volts working pressure and was tested for 25,000 volts for one-half hour between conductors and conductors and ground. It is about 4 in. in diameter and the shipping weight of each length of 800 ft. is about nine tons. It was made for the New York Edison Company and is to be laid under the Harlem River.

NEW CATALOGUES.

An attractive little folder (No. 4213) of 12 pages, illustrating and describing the advantages and construction of types B, F, H and J oil circuit breakers, has just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

Catalogue No. 110 from The Tungstolier Company, of Connaught, Ohio, is a unique and effective means of illustrating the construction of T T C Tungstoliers. These fixtures are made up of interchangeable parts, so that any style or type of fixture can be evolved. This feature is admirably shown in the catalogue by an ingenius sectionalizing method.

NEWS NOTES

FINANCIAL.

SEATTLE, WASH.—R. T. Laffin, district manager of the properties upon Puget Sound under the management of the Stone & Webster Engineering Association, announces that a plan has been prepared for the consolidation of a number of electric properties separately operated in the past in the Puget Sound district, and that a new company, namely, Puget Sound Traction, Light & Power Company, has been formed for the purpose of acquiring these properties and enlarging their usefulness. The properties include: The Seattle Electric Company, Pacific Coast Power Company, Seattle-Tacoma Power Company, Whatcom County Railway & Light Company, Puget Sound Electric Railway.

RED BLUFF, CAL. The Oro Water, Light and Power Company, operating in Butte County, and with head offices in San Francisco, has purchased the interests of the Butte and Tehama Power and Irrigation Company and the Sierra Irrigation Company. Neither of these concerns has done much development work, but their holdings on Mill Creek are valuable. The Oro Company has been operating in and about Oroville for many years, and lately has been preparing to erect additional plants and extend its lines to Sacramento and on to San Francisco Bay. A large generating plant on Mill Creek will be erected at once. The applications made to the Federal Government for rights on the Government lands for the two concerns that have been purchased will be pressed by the Oro Company, as the new company's works and lines will have to be built on forest reserve lands in Butte and Tehama counties.

INCORPORATIONS.

EPHRATA, WASH.—Green Valley Telephone Company, $5000, A. Owen, J. Pierce.

SEATTLE, WASH.—Kirkland-Redmond Railway, Light & Power Company, $200,000, by B. F. Gerdon, C. A. Eaton and others.

EUREKA, CAL. The Eureka Electric and Engineering Company, $75,000, shares $10 each, subscribed $50, by O. F. Metz, H. L. Morrison, O. L. Berry, E. E. and E. L. Combs.

LOS ANGELES, CAL.—International Fuse Lighter and Electric Manufacturing Company; incorporators H. H. Meurs, Joseph Anchell, D. M. Potter, F. Fette; capital stock, $1,000,000.

BOISE IDAHO—Articles of incorporation of the Idaho-Utah Electric Company have been filed. The company will provide power and illumination for Preston and possibly other towns near by.

LOS ANGELES, CAL. General Operating and Construction Company; incorporators, C. S. S. Forney, H. B. Landes, F. E. Miller J. L. McCalley, DeWitt S. Childers; capital stock, $50,000.

VANCOUVER, B. C.—The Canadian Western Light, Heat, Oil, Gas & Power Company of Alberta, a $5,000,000 corporation, has been floated in London by Eugene Coste, M. E. The company will serve the cities of Southwestern Alberta.

SAN BERNARDINO, CAL.—The Needles Gas and Electric Company has organized with capital stock of $100,000 to supply the town of Needles with gas and electricity. The directors are: Henry Torchiana, B. L. Devol and A. Mildreth of Los Angeles.

RAYMOND, WASH.—Articles of incorporation have been filed with the secretary of state for a company which will build a new electric line between here and South Bend. Capitalization is $200,000. Trustees are Jay D. Crary, J. B. Bridges and Theodore B. Bruner.

ILLUMINATION.

GRASS VALLEY, CAL.—The Pacific Gas & Electric Company has announced its intention, long talked of, of metering the city.

DOWNEY, CAL. The West Coast Light & Fuel Company, organized by residents of Bellflower, has applied for a gas franchise at Compoc and in territory east of that town.

METROPOLIS, NEV.—A 25 kw., 2300 volt, 60 cycle, a.c. generator, driven by a four cylinder four cycle gas engine, as furnished by the General Electric Company, has just been installed here.

AVALON, CAL.—An effort is being made by property owners to induce the Freeholders' Improvement Association to install a gas plant to replace the gasoline lamps, on account of which high insurance is charged.

LOS ANGELES, CAL. The Board of Public Works awarded a contract to the Los Angeles Gas & Electric Company at $6.30 per month per lamp for 3200 lamps in use and for an additional 500 lamps to be installed during the year.

SACRAMENTO, CAL.—The bid of the Pacific Gas & Electric Company for lighting the city has been accepted, which means the city, during 1912, will pay $6 per month for ordinary street lights, and $4.40 per month for electroliers containing five lights each.

SAN JOSE, CAL.—A franchise for the installation of pole lines for electrical power distribution has been granted the Great Western Power Company, which contemplates competing in the local field with the Pacific Gas & Electric Company with its Blue Lake system.

YUBA CITY, CAL. The Live Oak and Encinal Light & Power Company, which for several years has been supplying the town of Live Oak and vicinity and the country south of town as far as Encinal, has passed into history, and the Pacific Gas & Electric Company taken control.

STOCKTON, CAL. City Engineer Budd has recommended that C. L. Cory, an electrical engineer of San Francisco, be retained at a salary of $1000 to serve as consulting engineer in the designing and constructing of the proposed municipal electrolier system for the business district. Mr. Budd stated that specifications would be ready by the first of March.

OAKLAND, CAL.—Municipal ownership of a distributing system for street lighting is contemplated by Commissioner of Public Health and Safety F. C. Turner, who believes that the city is paying too great a price at the present time. The lighting bill now amounts to over $140,000 per annum. City Electrician George Babcock is checking up the cost of lighting under different systems, electroliers, arc lights, tungstens and gas lighting and comparing rates.

TRANSPORTATION.

SANTA CLARA, CAL.—The Peninsular Railroad Company has asked for a franchise to lay a railroad track over certain streets of town.

OAKLAND, CAL.—A 50-year franchise will be granted to the Oakland Traction Company for its extension along Arlington road, from the northern boundary of Berkeley to the county road.

SANTA MONICA, CAL. Pacific Electric Railway Company is replacing ties on its double track lines throughout the city and all divisions.

STOCKTON, CAL.—The Tidewater & Southern Railway Company, now building a line between Stockton and Turlock, has been granted a franchise to enter this city on Scott avenue, with a single track.

SAN DIEGO, CAL.—The district in which all but trolley wires must be laid underground has been extended to include Third, Fourth and Sixth streets, from B to H and was mapped out for the year of 1912.

WHITTIER, CAL. With a view of forcing the Pacific Electric company to put double tracks on West Philadelphia street, where the line enters the city, the City Council has instructed that the matter be taken up immediately with Paul Shoup, general manager of the road.

SAN FRANCISCO, CAL.—Report of United Railroads.

	1911	1910	Increase
November gross	$674,089	$633,613	$40,471
Expenses	351,123	350,465	663
November net	322,961	283,153	39,808

MONTEREY, CAL. An electric railway is to be built from Pacific Grove, to Pebble Beach. A clearing of the right of-way through the 17th Mile Reservation from Lake Majela, the end of the Southern Pacific Railroad, is now being made. The electric railway is to be built by the Pacific Improvement Company.

SEATTLE, WASH.—The directors of the Puget Sound Electric Company have passed the semi-annual dividend on the preferred stock due January 1. President Jacob Furth says the company cannot pay the dividend because of inadequate returns from passenger traffic under the existing fares, put in force by the public utilities commission of the State, some months ago and later sustained by the Supreme Court of Washington.

PORTLAND, ORE.—The Southern Pacific Company has applied for a double track franchise at Newberg and expects within a year to have electric service into that city. The Oregon Electric seeks a single track franchise over some of the same streets through which the Southern Pacific wants to operate and those who are advancing the claims of the Hill road are trying to grant two single-track franchises one to either company. Southern Pacific officials are unwilling to accept such an arrangement.

TELEPHONE AND TELEGRAPH.

HILLSBORO, ORE. The county court has granted to Martin & Forbes Company, a franchise to construct a telephone line from Base Line road to Haynes station.

PASO ROBLES, CAL. Several of the farmers in the Oak Flat district held a meeting for the purpose of forming a new farmers' telephone company to connect with Paso Robles. The proposed line will cost from $700 to $1000.

OMAK, WASH. Arrangements have been completed whereby the patrons of the Farmers Telephone Company and the Okanogan Telephone & Telegraph Company can use each line between this place and Okanogan at a cost of 15 cents.

SOUTH BEND, WASH.—Capt. Winbeck of the North Cove life saving stations has secured the recommendation of the inspector of life saving stations for a telephone line from South Bend to the North Cove station, which is now isolated.

VANCOUVER, B. C.—The British Columbia Telephone Company will shortly begin the construction of the Highland Exchange, and also the laying of a cable to connect Vancouver with North Vancouver. The exchange is expected to cost $200,000 and the cable about $30,000.

BAKERSFIELD, CAL. The contract for the erection of the Pacific Telephone & Telephone Company's three-story fireproof building, on 20th street between I street and Chester avenue, has been awarded to Carl Leonhardt, the Los Angeles contractor. It will cost $130,000.

SAN FRANCISCO, CAL.—The telephone merger proposition has been killed. There were pending before the board two bills. The first requested the two companies to merge and gave the Home company permission to sell out. The second, framed by the law department of the Chamber of Commerce, left out the request and merely asked permission for the merger and presribed conditions calculated to protect the city's interests.

HUSUM, WASH.—The telephone war between the proposed Husum Telephone Company, recently organized here, and the White Salmon Valley Telephone Company, in operation for the past six years, has reached a serious stage. The old company still maintains the additional toll of 5 cents for switching, while the members of the newly organized company assert that their line will be built and rates will be reduced. J. Butcher, a representative of the Pacific Telephone & Telegraph Company, accompanied by J. Smithson, manager of the White Salmon Valley Telephone Company, recently interviewed subscribers of the latter company in the vicinity of Husum relative to whether the subscribers preferred to keep the phones with the additional charges or to have the same removed at once. Preferring not to sign up for a limited time, some 60 instruments were ordered out by the subscribers in the vicinity of Husum, Laurel, Fulda,, and Glenwood.

TRANSMISSION.

DOUGLAS, ARIZ. The Douglas Power Company will probably extend a power line from the county farm through the valley in the next few months. The merger of public utilities in Douglas means enlargement.

BREMERTON, WASH. The Bremerton & Charleston Light & Fuel Company have placed an order with the Standard Underground Cable Company for a 4-conductor 2300-volt submarine cable to be laid between the powerhouse and Monette, to supply the recently installed distributing system. Rudolph W. Van Norden is acting as consulting engineer for the company.

BISHOP, CAL. The Fort Wayne Electric Works is now installing the switchboard and control apparatus for the Southern Sierras Power Company to tie in and operate its new transmission line with that of the Nevada, California, Power Company at Bishop. The Southern Sierras line, which is to be 240 miles in length, is designed to operate ultimately at 150,000 volts and the potential transformers, etc., are built to operate on this voltage.

EVERETT, WASH. Corporations using the streets for wire-carrying poles will be taxed 50 cents a year on each pole, if Everett's new charter is accepted by the people at the coming election. The original provision considered by the charter commission was that the corporations be compelled to pay $2 per annum, but a compromise reduced the rate to 50 cents. If the charter becomes effective it is predicted that many poles will be removed and the wires buried, thereby assisting the "city beautiful" movement.

WHITE BLUFFS, WASH.—The plans of the Pacific Power & Light Company for development in the White Bluffs country for the coming year includes increase of hydroelectric power at the foot of Priest rapids by the construction of a dam to cost between $4,000,000 and $6,000,000, which will take from four to six years to complete. Another item which will have a material effect this year upon the ultimate reclamation of the great valley of the White Bluffs country is the building of the Pacific Power & Light Company's high line

ditch which will water 30,000 acres bordering White Bluffs on the west. The engineers are now finishing their surveys, the grading will be commenced within thirty days, and the canal should be ready to deliver water for fall irrigation this year.

MONTPELIER, IDAHO.—The Telluride (Colo.) Power Company has been granted an electric-lighting and power franchise at Montpelier. The grant provides that the company must have the proposed system in operation within nine months. The company is said to have applied for a similar franchise at Salt Lake City, Utah.

LOS ANGELES, CAL.—A mortgage has been recorded here for $35,000,000 by the Pacific Light & Power Company to the U. S. Mortgage & Trust Company, New York, which covers all the former concern's holdings in this State. The funds are to be used in the further development of power and extending the scope of the corporation's operations in California. Much of the money is immediately available. Ten millions is to go into the construction of one of the greatest power units in the world, on Big Creek, in the lower end of the San Joaquin Valley, where 150,000 h.p. will be developed. Distributing stations are to be built throughout that valley and elsewhere in Southern California for the dissemination of electrical energy to railways and commercial enterprises. Thirty thousand square miles of land in the San Joaquin Valley are to be developed.

LOS ANGELES, CAL.—The Southern Sierras Power Company is a subsidiary of The Nevada-California Power Company, which has been operating during the past six years, marketing most of its product in Goldfield, Tonopah, Manhattan, Round Mountain and other points in Nevada. The Nevada-California Power Company will furnish The Southern Sierras Power Company its surplus. The transmission line of The Southern Sierras Company is to be 240 miles of a double circuit, steel tower construction, through the valley of Owens River, thence through the Inyo-Kern country to Johannesburg, and thence to Oro Grande, Victorville, Hesperia and San Bernardino. In San Bernardino the company is now building a steam auxiliary plant, and it is proposed to have the new plant and the new transmission line in operation by the first of March, 1912. The company is also building a distributing line from San Bernardino to Perris and Elsinore, with branch lines to San Jacinto and Hemet. It is also building a line from San Bernardino, on the north side of the Santa Ana River, to Corona. T. C. Dobbins of Los Angeles has a $250,000 contract from the Sierras Construction Company to construct the line. The steel towers are seventy feet high and carry the six aluminum transmission cables. The voltage will be 110,000. These towers are to be raised by a wormed gear on a three and one-half ton Alco truck. The power of the truck is utilized to raise the towers in place, the towers being assembled before raising. There are eight of these steel towers to the mile, 660 feet apart, making a total of about 2000 towers. Manifold and Poole are engineers for the Southern Sierras Power Company. The officers and directors of the company are: Thomas S. Hayden of Denver, president; Delos A. Chappell, Los Angeles, vice-president; W. E. Porter, Denver, secretary; Lawrence C. Phipps, Jr., Denver, treasurer, and Guilford S. Wood.

WATERWORKS.

GRANDVIEW, WASH.—Work is to be started immediately on the Grandview water system.

SANTA MONICA, CAL.—The water company is preparing to lay mains throughout the new residential section east of Seventh street and north of Nevada.

NORTH YAKIMA, WASH.—Wapato has mad a contract with the Fairbanks-Morse Company for the installation of a water supply system to cost $7500.

FRIDAY HARBOR, WASH.—Dr. Caipron, Chas. Baker, and J. P. Paine have been appointed as a committee to investigate the proposition of a water supply for Friday Harbor.

NOGALES, ARIZ.—The Nogales Water Company has made application for an injunction to restain the town council from disposing of the water bonds on the ground that the request of installation of the municipal water system would prove financially disastrous to the town. The company offers to sell its property and plant to the town for $60,000 cash.

LOS ANGELES, CAL.—The Board of Supervisors will receive sealed bids up to February 5 for the purchase of franchise granting the right to maintain a system of water pipes for a period of 40 years in a certain portion of the county, beginning at the corner of Lot 1, Maxon's Subdivision, then west along Linda Vista avenue.

ASOTIN, WASH.—Among the bids received by the council for the purchase of the $30,000 worth of water bonds was the joint bid of Allen and Wells and the Fidelity National Bank of Spokane, bid being for $30,282 bonds to bear interest of 6 per cent. The contractor, Mr. W. H. Mitchell of Seattle, will in all probability get busy on the water system by the first of the year.

NEVIS, CAL.—The temporary electric power plant of the Great Western Power Company, below Butte Valley has been completed and is ready for the delivery of the power to Nevis. The capacity of the plant is 1500 h.p. The power from the Butte Valley plant will be used for the construction operation of the electric power company at Nevis, which involves the building of a dam to form a reservoir covering over 30,000 acres in Big Meadows.

OAKLAND, CAL.—The Peoples Water Company has receded from its position of refusal to comply with the directions of the City Council for the reduction of water rates in particular cases where it was asserted that overcharges had been made. Disagreements arose over a reading of the ordinances of the city, which Mayor Mott admitted were ambiguous, in relation to the right of the company to install a meter through which several buildings were served and then charge the minimum rate for each of the buildings.

WALNUT CREEK, CAL. Although Mrs. Mady Lacassie offered to furnish water free for fire and street sprinkling the Walnut Creek Business Men's Association has declared in favor of the R. N Burgess Company. The concern promises 70,000 gallons daily, while Mrs. Lacassie can furnish only 10,000 gallons. The Burgess company already has installed water hydrants and will begin immediate service from artesian wells in the vicinity. The association also appointed a committee consisting of George T. Crompton and Capt. Geo. O. Duncan to confer with the Home Telephone Company and arrange for a direct line with Oakland.

BAKERSFIELD, CAL.—The Bakersfield Water Company, which recently took over the Sumner Water Company's system in East Bakersfield, is installing two 2-stage turbine pumps and two 75 h.p. motors in the Humboldt station, which contains two 10 inch wells, the pumps to have a capacity of 1200 gallons per minute, each. The San Joaquin Light & Power Company, is putting in two power lines to the station, one of which will be fed from the power generating plant at the mouth of Kern River canyon, and the other one of which will draw from the main power circuit that swings around the north end of the valley and is supplied by the great power plant in Crane Valley and the auxiliary steam plant in the northern part of this city. These two lines will give the water company a double assurance of uninterrupted power, but as a third safeguard gasoline engines are to be installed for use in case both the electric power lines are out of commission at once.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JANUARY 20, 1912 | NUMBER 3

RECONSTRUCTION OF FORDYCE DAM

BY E. L. HODGE.

Lake Fordyce, one of the largest storage reservoirs of the Pacific Gas & Electric Company, with an area of approximately 510 acres, and 875,000,000 cubic feet capacity, is situated far in the eastern part of Placer County, and about seven miles from the summit of the Sierra Nevada Mountains. The lake is about eight miles due north of the Southern Pacific Railway tracks passing Cisco station, and can best be described as an immense basin, surrounded by high and precipitous mountains of granite, and consequently almost inaccessible except by foot travel or by horse-back over rough mountain trails.

Fig. 1. Fordyce Dam, Showing Location of New Tunnel.

The retaining dam at Fordyce is practically 800 ft. long, 139 ft. thick at the foundation, five feet across the top, and 92 ft. high. This dam was built years ago for the purpose of storing water in conjunction with the old South Yuba Water Company system. The face of the dam is at present sheathed with heavy planking (see Fig. 2). In the spring of 1911 it was decided to put in a concrete cut-off wall along the entire toe of the dam and also to reinforce the crest of the dam, block the old spillway, and build a new outlet tunnel. Fig. 1 shows the excavation necessary to establish a permanent and solid foundation at the toe of the dam for the cut-off wall.

In order to carry on this construction work, it was necessary to practically empty the lake of its water (see Fig. 3), and establish a permanent headquarters camp adjacent to the work to care for the two hundred-odd men needed in this reconstruction.

Owing to the almost impassable mountain barriers between Cisco, on the line of the Southern Pacific, and Lake Fordyce, the immense amount of construction material, consisting of heavy machinery, such as air compressors, boilers, hoisting equipment, dam cars, etc., necessary to carry on this gigantic work, was taken in a long detour from Truckee north by way of Weber Lake, a two-days' haul, and down into the northern end of Lake Fordyce, thence by boat and rafts to the dam. The camp supplies for the commissary were taken in by pack trains from Cisco over the mountains. When this work is entirely completed, the Fordyce Dam will be in excellent condition for many years to come.

Fordyce is at an altitude of 6,300 feet above sea level, and even as late as July 1st oftentimes snow remains upon the ground, and the nights are sharp with heavy frost. The first winter snows fell at Fordyce, October 25th, 1911. The season, consequently, when work can be performed in these mountains is extremely short. Eighteen to twenty feet of snow is the usual winter's depth, and the headquarters house shown in illustration, Fig. 4, is oftentimes buried, so that the two lake tenders are compelled to enter and leave by the window shown in the extreme top of the gable end.

This picture also shows wood being stored for the long winter season, and on the porch are a number of Norwegian skis which are used in traveling over

the country during the winter months. El Roenig, in charge of Lake Fordyce, has lived in these mountains as caretaker of Lake Fordyce, Sterling and Meadow Lake for 39 years. His only companion is Gus Anderson, and many times these two rugged Scandinavians pass several months during the extreme winter, snowed in and ice-bound, without ever seeing a human being. When it is possible to get out, and the snow is tightly packed, they take a little jaunt on their skis over the mountains to Cisco and back again, a distance of about 16 miles. Uphill and downhill they wend their way, being experts on snow shoes, and where the going is good they indulge in long coasting spurts of several miles.

A large portion of the bed of Lake Fordyce was at one time rich meadow and timber land, and, in fact, a large ranch occupied one end of the valley. In Fig. 16 old stumps of what were at one time standing trees can be seen, and are now almost entirely submerged except at extremely low water.

Lake Fordyce abounds in fine trout, which are being preserved by the Pacific Gas & Electric Company during this construction work, small dams having been built and sufficient water retained to care for the fish until the lake is again refilled.

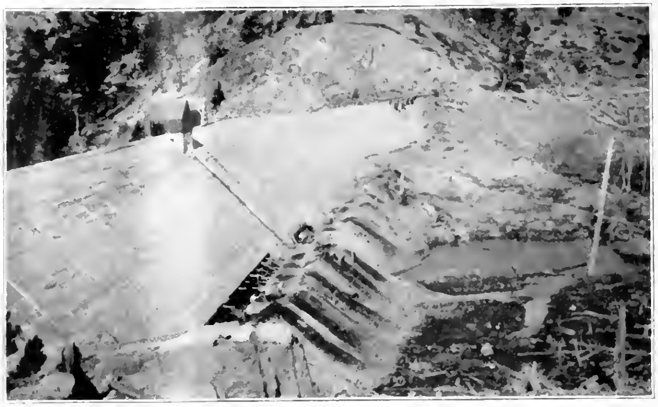


Fig. 2. Face of Fordyce Dam.

Fig. 3. Bed of Lake Fordyce.

Fig. 4. Headquarters House, Lake Fordyce.

South Yuba System.

Lakes.	Acres	Capacity (Cu. Ft.)
Blue Lake	63	49,000,000
Bear Valley (reservoir)	60	14,000,000
Culbertson Lake	67	30,000,000
Feeley Lakes	67	37,000,000
Fuller Lake	67.5	10,000,000
Lake Fordyce	510	875,000,000
Lake Spaulding	215.5	251,900,000
Lake Sterling	104	71,800,000
Lake Valley Lakes	260	230,000,000
Lake Van Norden	390	230,000,000
Lindsey Lake	49.3	13,300,000
Meadow Lake	249	200,000,000
Rock Lakes	23.9	10,300,000
Rucker Lake	63	22,600,000
White Rock Lake	90	180,000,000
Totals	2,279.2	2,257,900,000

DITCH FLOW EACH SECOND.

[illegible]	Cu. Ft.	Miner's Inches.
Main South Yuba	[illegible]	8,000
[illegible]	75	3,000

PHYSICAL VALUATION OF ELECTRICAL PROPERTIES IN OREGON.[1]

BY R. H. DEARBORN

The appointment of state commissions for the purposes of taxation and regulation of public service corporations is rapidly becoming the practice of the more progressive States. The evils of competition in public utilities, the abuse of certain privileges and the necessity for some fair basis of rates to different classes of customers have all demanded the services of a just judge, who will recognize at once the rights of the public to fair and reasonable service, and the rights of the corporation to a fair return on their investment.

This arbiter of public and private rights is at present represented by the state commission in some form, and the development of the commission plan is thought to be a probable solution of the problem. The case for the state commission is well presented by Governor McGovern of Wisconsin in a recent address before the Conference of Governors on the subject of "State Control of Public Utilities," reported in full in the Electrical World for September 23, 1911, and dealing especially with results in his own state. His discussion brings out the fact that a properly constituted commission may accomplish results that are beneficial both to the public and to the operating companies: to the people in improved service and a fair rate, and to the average company by eliminating competition, and sometimes by improving their methods of operating and accounting.

Thomas N. McCarter, president of the New Jersey Public Service Corporation, at one time opposed to the commission plan of regulation, has recently gone on record as believing in public utility legislation as a protection to the corporation rather than a menace.

On the other side of the question, the possible failure of the commission plan to [illegible] the regulation of rates of public service corporations is suggested by H. M. Byllesby in an article in the Proceedings of A. I. E. E. for September, 1911, in which he calls attention to the grave responsibilities resting on the engineers for the commission in determining what is a fair and just rate for service rendered in the case of a large corporation with its varied and intricate financial problems, all of of which must be considered and passed upon before any estimate of a fair rate can be made.

Two of the more important lines of work undertaken by state commissions that affect the electrical corporations are: (1) regulation of rates, service, and accounting, (2) physical valuation for purposes of taxation. These are closely allied, the second being an important part of the first, although at times separate. Regulation of rates, service, etc., present very much the larger problem; the variables are increased by many so called intangible values by the going value, etc.; factors which demand from the engineers of the commission handling these questions an unusual business ability, a keen insight into the operating conditions and a rare sense of justice. The second point, the physical valuation of the properties for furnishing the basis for taxation, is but one phase of a large question before the country today; the discussion of a method for taxation of public utilities. This question, however, is beyond the scope of this paper.

The physical valuation according to the Wisconsin law should include "all the physical property, and all property used and useful for the convenience of the public." This physical valuation for taxation purposes should include (1) all real estate, (2) all materials entering into the construction, (3) all transportation and labor charges, (4) all fees for engineering and supervision. Valuation for rate making or for purchase should include in addition to the above the socalled intangible values.

The legislature of the State of Oregon at its last session passed a bill creating a Public Utilties Commission having under its jurisdiction the question of rates, service, valuation, etc., of public utilities. This bill after passage was held up by referendum and will finally be passed on by a vote of the people in November, 1912.

The work of appraisement of electric properties in the State of Oregon for purposes of taxation was [illegible] taken up more definitely by the present tax commission for the purpose of beginning the compilation of accurate valuations. This work of physical valuation of these properties operating in more than one county of this State was undertaken by the [illegible] at the request of the commission during July, August, and September, 1911. The plan first considered by the commission called for a detailed investigation of one or two properties during the summer. [illegible] because of the inaccurate character of previous [illegible] it was decided by the commission to make an approximate estimate of all the electrical properties [illegible] by the State to insure that all operating companies should be on the same basis with regard to [illegible] this to be followed by an accurate and detailed estimate to be taken up at a later date when circumstances permitted.

The systems of which approximate physical valuations were made included the Oregon Power Company [illegible] Willamette Valley, the Rogue River Electric Company, and the Klamath Falls Power Company in Southern Oregon (both recently absorbed by the Siskiyou Power Company), the Pacific Power & Light Company in the Astoria and Pendleton districts, and the Eastern Oregon Light & Power Company serving [illegible] and the Grande Ronde Valley. The Portland Railway Light & Power Company had recently [illegible] in a report so this company was not included.

The number of companies and the large amount of territory to be covered in a very short time made it necessary to adopt some system that would approximate the [illegible] and insure an equable assessment [illegible] without the labor and time [illegible] estimates of all the details of construction [illegible] separation of items of engineering [illegible] during construction, contingencies, etc. [illegible] these latter items were combined in a percentage depending on the local conditions.

[illegible] based on one of two [illegible] the installation, less depreciation [illegible] new, less depreciation [illegible] and inaccurate records of [illegible] original companies, most of which had

[1]Paper presented before Portland Section A. I. E. E. [illegible] 21, 1911.

changed hands several times, it was impossible to get first costs of many of these properties, so the latter method was employed.

The work consisted of the inspection of all real estate, plants, sub-stations, transmission lines, and distributing systems, and their appraisement on this basis of replacement new, less depreciation for the number of years installed. The errors of this assumption are due to the difference in costs of material and labor now, and at the time of erection; and the larger difference between construction completed at one time and the so-called piece meal construction. Rates of depreciation on power houses, sub-stations and all machinery installed were based on the figures given by Mr. Henry Floy in the Proceedings of the A. I. E. E. for June, 1911, The straight line method was adopted because of its simplicity.

Rates of depreciation on transmission lines and distributing systems were based on the average life of such systems in that locality, taking into consideration the materials, type of construction, and climatic conditions. The valuations of the distributing systems in the towns were based on the number of poles, miles of wire, number and capacity of transformers, meters and services. A large percentage of these figures were taken from company records, which were available, but in some cases these were estimated from average figures obtained from statistics of similar towns similarly served in this State. Depreciation was figured on the average life of the distributing system.

The actual valuations made on the electrical properties are believed by the writer to be uniformly low. This is due in part to causes already mentioned. Two of the most important of these are: (1) The well recognized difference between costs of construction work carried out completely at one time, and the costs when the same work is carried out by a series of additions, the latter the usual conditions in the case of companies serving rapidly developing communities. (2) The limited time available for covering a large territory; the impossibility of making complete investigation of transportation and labor costs, of foundations, and hydraulic work will be readily recognized.

One of the interesting features brought out by the work was the grouping of the various districts of the State for the electrical service. (At this point a map of the State showing the districts served by the various companies was shown and a brief description of each system was given bringing out the interesting features of each.)

As shown by the map of the Umpqua Valley is the only populous area, which is not served by one of these five companies. A further evidence of the completeness of this distribution is shown by the fact that of the twenty towns of the State which have more than two thousand population according to the last census but three are not served by one of the companies.

Some of the figures obtained for the distributing systems may be of interest, showing the uniformity in towns of similar size, even where the type of load is somewhat different. Below are tabulated the figures of the distributing systems of ten towns with population ranging from four thousand to ten thousand reduced to a basis of one thousand population.

					Transformers		
	Poles.	Miles of Wire.	Meters.	Serv-ices.	No.	Capacity kw.	Average Capacity per Tran.
1	125	10	170	207	11	118	8.5
2	108	10	150	163	13.3	106	8
3	116	10.6	126	110	12.6	70	5.5
4	120	11.1	101	132	15.1	151	10
5	123	9.5	114	125	13.3	91	7
6	105	10	160	160	10	119	11
7	50	8	108	125	9.3	70	7.5
8	110	9.5	150	150	22	121	5.5
9	170	10	112	112	19	92	5
10	160	12	45	125	17	85	5

Approximate averages:

Per 1000 population.

				Transformers.		
Poles.	Miles of Wire.	Meters.	Services.	Number.	Capac. In kw.	Aver. Capac. per Tran.
120	10	125	115	14	105	7.5

In several instances there are figures very different from the average, due to local conditions, but on the whole, I believe the averages are close enough for approximate estimates on towns in Oregon between the limits of population mentioned.

Many interesting facts came out in connection with the summer's work, but these few will serve to show some of the questions to be considered in an appraisement of the electrical systems of the State. It is to be sincerely hoped that the work of the commission in Oregon will be extended until the State has accurate data available for the various and important uses of the commissions. The State is comparatively new, and the problem undertaken at this time should be much easier of solution than in the other States which have a larger number of systems with larger investments in public utilities. With an accurate estimate of the electrical properties at present existing in the State the yearly additions made by the companies could be easily estimated, keeping these valuations up to date with comparatively slight expense to the State.

The increasing distance over which electrical power may be transmitted economically and the undoubted gain that comes from consolidation of many plants in a larger network points to the ultimate combination of several of the systems, which are now considered large, in a greater system with great improvement in diversity factor and in load factor, due to irrigation and electrical heating loads, which will probably result in lowering of rates and improved service

Companies of this type with the courage to expand a little ahead of the development of the country, with their close organization, and the highest engineering and financial ability available, are the first to recognize the value of a rightly constituted commission, which will portect, not only the interests of the people but that of the public service corporation as well.

WIRELESS FIGHTING OF FOREST FIRES.

Wireless telegraphy will become a factor in the prevention of forest fires in Montana, if experiments planned by R. P. McLaughlin, forest supervisor, are successful. It is proposed to establish a station and open communication with the wireless plant at the Kalispell High School. If the experiment is successful several stations to be operated in connection with the telephone system already in operation, will be organized.

DRILLING BOILERS IN THE CALIFORNIA OIL FIELDS.

BY A. L. MENZIN

In the selection and installation of mechanical equipment, the personal preferences of men play only a minor part in comparison with the dictates of local conditions. The effects of high costs of materials and scarcity of skilled labor and transportation facilities are particularly noticeable in the oil fields, especially in the crude and make-shift manner of setting the steam boilers used in drilling and pumping.

Owing to the many complex operations involved in the drilling and upkeep of wells, apparatus, as well as methods, have been standardized to a high degree. For drilling purposes, and for pumping the well after it is made productive, until superseded by a more permanent plant, the boiler commonly used is of the horizontal return tubular type, 48 inches in diameter by 12 feet long, with forty 3-inch tubes expanded between heads. They are built for 100 pounds working pressure. Since good water is seldom obtainable, it is necessary to provide facilities for cleaning; hence there is usually a manhole in the front head below the tubes and another manhole in the rear head above the tubes. Although manufacturers of this type of boiler frequently put a manhole in the top of the shell instead of in the rear head, such an arrangement would not be satisfactory for oil country service since the top of the shell is usually covered with loose dirt or oil sand to decrease the loss of heat by radiation and conduction. Boilers are usually fitted with steam domes for, in drilling and cleaning wells, sudden demands for steam are not uncommon.

Fig. 1. Boiler Setting With Steam Dome

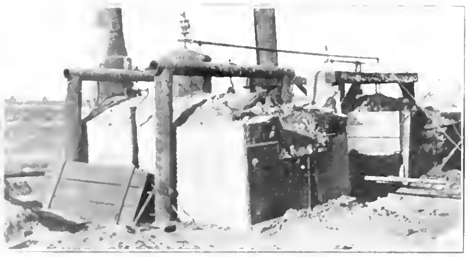


Fig. 2. Rear View of Boiler Setting

The stacks are of sheet iron, and are usually 22 inches in diameter and 20 feet long. Dampers are not installed as a rule.

Although boilers of the type described are very common wherever steam is used, the method of setting them adopted in the oil fields is entirely different from that met with elsewhere. The photographs, Figs. 1 and 2, show a front and rear view of the typical "mud settings." Both boilers are suspended from gallows frames by means of bolts linked with hangers riveted to the top of the boiler shell. The distance from the ground to the bottom of the shell is usually about 30 inches. The sides and rear of the setting are made up of a 13 or 18 inch wall of red brick laid up dry without mortar and backed up with dirt to make the walls about 30 inches thick. The dirt is kept in place by boards or sheet iron on the sides and castings at the rear. The roof of the rear uptake is of red brick supported by 90-degree arch bars which rest on the rear wall and against the boiler. A layer of dirt or oil sand is thrown over this roof and over the top of the shell for obvious reasons. The furnace floor is of dirt. Fire brick is seldom used in these settings.

The left hand boiler of Fig. 1 is erected with the older type of mud setting. The gallows frames are made up of square timbers and the retaining walls for the dirt are also of wood. The right hand boiler has the newer type of setting. The gallows frames are made of old well casing and the retaining walls are of corrugated sheet iron. This latter setting is fireproof and is now used whenever the material required are available.

There are many good reasons for the adoption of such a setting in the oil fields. Brick, lime, sand and cement are very expensive, and bricklayers are scarce. It frequently happens that a boiler has to be moved, either because the well is abandoned, or for other reasons. It is then a simple matter to pull down the boiler and setting, move the materials to the new site and erect them again with the ordinary labor available. Such a setting is, of course, not conducive to high efficiency but that, as in all development work, is secondary to low first cost.

Patented oil burners are practically unknown in the oil fields. Every operator makes his own burner out of ordinary pipe fittings. The construction varies somewhat, depending on the personal ideas of the maker and the quality of the oil burned, but the general principle is illustrated in the sketch Fig. 3. These burners make a very satisfactory fire and seem to require very little steam for atomizing since it is only necessary to "crack" the steam valve a very little to make a good forty horsepower fire. No oil pumps are required or used—the oil being supplied by gravity from a tank set from 6 to 10 feet above the ground. However, these burners will operate with a much lower head of oil. The writer has made a good fire with one of these burners when the surface of the oil was not more than 3 feet above the burner.

An important peculiarity of this burner is that it is self-regulating to a great extent. The impact of the jet of steam issuing from the inner pipe against the burner tip produces a back pressure on the oil issuing from the annular space between pipes. If the steam valve is set for good atomization, any increase of the steam pressure will cause more steam to flow through the inner pipe. This will increase the back pressure [illegible] and choke back the oil coming from the [illegible], thus decreasing the fire. If, on the

other hand, the steam pressure drops, the back pressure at the tip will be decreased, more oil will flow, and the fire will be increased.

This type of burner is very sensitive to variations in steam pressure. As the steam pressure goes up the fire is cut down until a point is reached when the fire

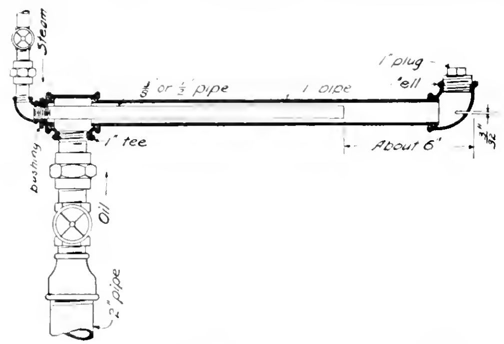


Fig. 3. The "Home-Made" Burner of the Oil Fields.

becomes spasmodic—it almost goes out and then starts up again with explosive action. It is then said to "buck."

Another peculiarity of the burner is that it will begin to atomize when the steam pressure is less than a pound above atmospheric. As soon as a "sizzle" is heard issuing from the steam pipe and before the needle of the steam gauge has left the pin, the burner will begin to atomize and will make a fairly good fire.

HYDROELECTRIC DEVELOPMENT IN MEXICO.

It is learned from an apparently reliable source that, through a concession, the German firm of Siemens & Halske, of Berlin, will shortly begin the construction of a large hydroelectric plant on the Balsas River in the State of Guerrero at the point where the main highway between the capital, Chilpancingo, and the city of Iguala crosses the same, that the sum of $14,000,000 is available therefor, and that the purpose of the plant will be to supply power for the many and important mines of this State along the Balsas River.

Salvador Ugarte has secured a contract for the installation of a new electric power plant at the mines of Guadalupe de los Reyes, Sinaloa.

These properties are among the most famous producers of the west coast interests. The new plant will consist of two charcoal gas-producer engines of 180 horsepower each, a reserve battery of two electric generators of 120 kilowatts each. It is expected to have the plant in operation by May, 1912. The new plant will greatly reduce the operating costs of the mines and reduction plant.

METER DEPOSITS HELD INVALID.

The practice of gas, electric and water companies of requiring deposit fees for the installation of meters has been held to be invalid by the State District Court of Appeals of California. The San Francisco Gas & Electric Company will carry an appeal to the State Supreme Court.

THE GRAPHICAL CONSTRUCTION OF AN INDICATOR CARD.[1]

BY ROBERT SIBLEY.

It not infrequently happens when taking indicator cards from a steam engine that a theoretical indicator card drawn to the simple scale of the card taken by means of the indicator appears of much practical import and comparison between ideal and operating conditions is at once noted and means of correcting irregularities suggested. It is possible to construct an ideal indicator card if we have given certain of the constants of the engine cylinder in question. These constants consist of the boiler pressure, the back pressure, point of cut-off, length of stroke, the point of compression, and the clearance.

In Fig. 1 we have an indicator card constructed from an engine cylinder having the boiler pressure of 80 lb. gauge and back pressure of 1.3 lb. gauge, the point of cut-off four inches out from the beginning of the stroke of 12 in. and clearance of 0.1 stroke or 2.4

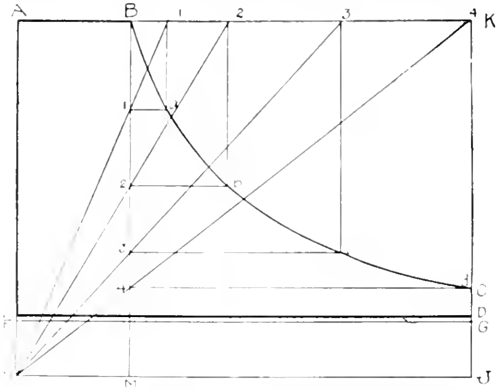


Fig. 1. A Theoretical Indicator Card-Clearance Neglected.

inches. In the construction of this card we first start with the line FG which is the zero line for gauge pressures and is commonly known in engineering practice as the atmospheric line. Selecting a point at F we next measure to a convenient scale the distance FH perpendicularly below FG a distance equal to 14.7 lb. or the pressure of the atmosphere above the absolute zero. We next extend FH vertically upward to A the distance FA being equal, on the same scale with which we drew FH, to 80 lb. The distance FE is next scaled off equal to 1.3 lb. which is in this case the pressure in lb. gauge of the exhaust steam as it leaves the engine cylinder. Through E and A we next draw the line ED and AB parallel to our atmospheric line FG. The point G is located to scale 24 in. to the right of point F, thereby making FG equal to the stroke of the engine cylinder. The point B is next located on the line AB distant 6 in. to the right of point A, thereby making the line AB equal to the distance from A at which the cut-off point B is located during the stroke of the piston head.

The next point of interest for our consideration is the construction of the expansion curve BC. We

[1]This paper comprises the Seventeenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

have previously seen that this curve is neither one of isothermal expansion nor adiabatic expansion but is situated intermediate between these two curves. As it approaches however more nearly the isothermal curve and as the isothermal curve is easily constructed, engineers generally assume that the curve is one of isothermal expansion. Fig. 1 represents an expansion curve BC in which the steam engine cylinder has no clearance. Fig 2 on the other hand represents a cylinder which has a clearance equal to 0.1 of the stroke. Let us first take the more simple case, that shown in Fig. 1 and see how we construct the expansion curve BC. We first produce the line AB to the right to K a sufficient distance to cover the stroke of the engine and platted to the same scale in which the point of cut-off B has previously been platted on the line AB. We next take any number of points, 1, 2, 3, etc., along the line BK. The more points we take, the more points we will eventually determine on our expansion curve. Let us next draw the perpendicular BM from B to the line HJ. We then draw a straight line H1 and where this line intersects the line BM we draw a horizontal line 1a to intersect the perpendicular line 1a. This point of intersection a is a point upon our expansion line. In identically the same way the points b, c, d, and any other points we desire to ascertain are determined. Finally the point at which the curve BC intersects the perpendicular GK is the termination of our curve.

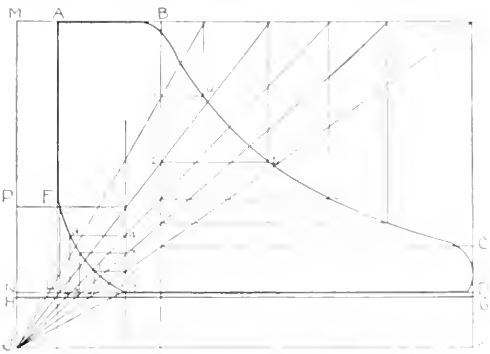


Fig. 2. A Theoretical Indica[illegible] Card—Cl[illegible] Considered.

Looking now at Fig. 2 we can at once extend the identical reasoning which we applied above to the case in which our engine cylinder has a certain amount of clearance. Let us construct this diagram in identically the same way we constructed Fig. 1, with the exception that the line QJ is located to the left along our absolute zero pressure line a distance equal to 0.1 of our stroke or 2.4 inches, as this is the amount of clearance given in this particular example. If now we use the point J in Fig. 2 in identically the same way we used the point H in Fig. 1 we construct at once the expansion curve BC for this particular case of clearance. In Fig. 1 the points B and C are theoretically located. As a matter of fact in the operation of the steam engine it takes time in which to open the valve, hence these points are shown ordinarily in practice more in a round shape BCD as indicated in Fig. 2.

Having now constructed the expansion curve, let us next proceed to the compression curve. Looking again at Fig. 2 let us assume in this case that compression takes place after the piston head has travelled 20 in. on its return stroke. Marking off then DE on our scale equal to 20 in. we next let drop a perpendicular line EO extended in both directions from E. Along the line EN we take a number of points 1, 2, 3, 4, etc. and draw lines 1J, 2J, 3J, etc., producing them upwardly to the right. At the intersection of the vertical perpendicular 2b line with the horizontal 2b we determine the point b which is a point on our compression line FE. In identically the same way the points a, c, d, etc., are determined on the compression curve EF. It is seen similar to the case in the construction of the expansion line that as many of these points are determined as we desire. Thus ABCDEF represents the ideal theoretic indicator card.

In the year 1902 a committee of the American Society of Mechanical Engineers made the report on engine tests which is printed in the transactions for that year. Among other things taken up in detail in this lengthy report of 78 pages is that of the question of determining the point of cut-off. We have seen that theoretically the point of cut-off is a definite point but practically speaking, due to time necessary in the opening of the steam valves, the point of cut off is not so definite. As a matter of fact, though somewhat indefinite, the point of cut-off is usually considered to be at an earlier point of the stroke than the beginning of the real expansion line. In order that the cut-off point may be defined in exact terms for commercial purposes as used in steam engine specifications and contracts, the committee above referred to, recommended that unless otherwise specified the commercial [illegible] which seems to be a preferred expression for this term, be ascertained as follows: through a point showing the maximum pressure during admission, draw a line parallel to the atmospheric line. Through the point on the expansion line near the actual cut-off [illegible] hyperbolic curve. The point where these two [illegible] is to be considered the commercial cut-off point. The percentage of cut off is often found by [illegible] length of the diagram measured to this [illegible] the total length of the diagram and multiplying the result by 100. The commercial cut-off as [illegible] named is situated at an earlier point of the stroke [illegible] the [illegible] cut off used in computing the [illegible] for by the indicator.

[illegible] this difference necessitates the construction [illegible] hyperbolic curve on the expansion line of the indicator card, it will be [illegible] to see how this is, as a matter of fact, [illegible] accomplished. According to the rule [illegible] should begin our curve more properly [illegible] on the expansion curve ABC [illegible] purposes, however, as the space [illegible] the line NL would [illegible] begin the construction of our curve [illegible] point B. Let us first [illegible] that the curve [illegible] indicator diagram [illegible] Parallel to the atmospheric line [illegible] the line OY a dist[illegible] 14 [illegible] this line, thus dra[illegible] pressure. We next dra[illegible] upward perpendicular to this [illegible] line OY at the point E and then [illegible] draw a perpendicular line

FG intersecting the line OY at G. The distance EG now represents to scale the stroke of the engine cylinder in question. It is next necessary to determine the clearance point O before we can proceed further.

We begin at two points along the expansion QB which are apparently even and characteristic. Looking at this curve we see that the points B and C indicate such a condition. Let us draw the horizontal lines BD and CE and at the points D and E at which the perpendicular lines CD and BE respectively intersect these horizontal lines, we draw the straight line DE. This line is now produced until it intersects the line of zero pressure EG at the point O. The distance OE scaled off will give us the clearance of our cylinder. Several different pairs of points may be similarly taken along the expansion line and the average intersection or the average O on the line of zero pressure EG will be more nearly correct for this point.

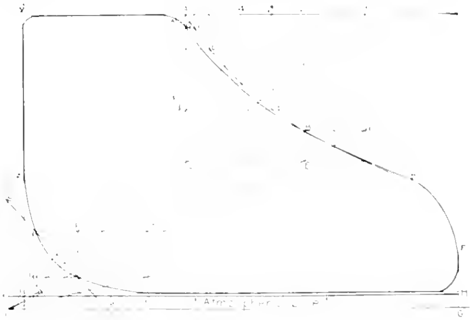


Fig. 3. Determination of Commercial Cut-Off Point.

Engineers have often found still another method of arriving at the location of the point O—in words, at the clearance value—by taking into consideration the compression curve. It is a property of the rectangular hyperbola that a line intersecting the horizontal and perpendicular axes at an angle of 45 degrees cuts off equal segments between the curve and the axes. Acting upon this principle let us draw the line MS so that this line intersects our curve at the points L and N making an angle NMO equal to 45 degrees. According to our law just announced we may now scale the distance LM with our dividers and make NS exactly equal to it. The perpendicular then let fall from S upon the zero pressure line EG will determine for us the point O which we are looking for. Many engineers consider this method more accurate than that of using the expansion line. It is a good plan, however, to utilize both methods in determining this point and then take an average value.

Having now definitely determined the zero point O we now proceed to construct the hyperbolic curve, the ideal expansion line as stated above. In order to meet the requirements of the committee of the American Society of Mechanical Engineers in the determining of the point of cut-off A, we should begin at the point Q on the expansion line. In order, however, to have more room for illustration we begin at the points B and C. As previously set forth the rectangle BDCE is constructed. The verticle line CD is then extended upward until it intersects the admission line XA produced at some point F. The diagonal line FO is then drawn and at the point where CE produced to the left intersects the line FO, the same being the point G, we erect a perpendicular GA. The point A is then the particular point in question for which we are in search; namely, the commercial point of cut-off.

By scaling off the distance XA we can at once determine the distance out from the beginning of the stroke at which the point of cut-off takes place. We can now determine as many intermediate points along this curve as we may desire, for by taking the points 1, 2, 3, 4, etc., along the line FA and connecting these points with the point O we can determine a series of points on the curve. For instance, let us note d', which is the point where the line 30 intersects the vertical line GA. Then by drawing the vertical line 3d and the horizontal line d'd to their point of intersection d we definitely determine this point d which is on our theoretic expansion curve. By an exactly similar method the points a, b, c, and as many others as we may desire are located.

Thermotwisters.

1. In a government test on a marine boiler made with California oil the following data were taken. The analysis of weight of the oil fuel was as follows: Carbon 81.52%; hydrogen 11.01%; sulphur 0.55%; oxygen 6.92%. The analysis of the chimney gases by means of an Orsat apparatus was in volume as follows: Carbon dioxide 6.6%; oxygen 12.6%; carbon monoxide 0.4%; nitrogen 80.4%. The temperature of the boiler room was 96° F., the temperature escaping chimney gases 743° F. and the temperature of the atomizing steam 378° F. The equivalent evaporation from and at 212° F. was 11.19 lb. of water per lb. of fuel oil. Determine the heat balance for the test. Steam used on atomization was 0.644 lb. per lb. of oil.

(a) The heat lost in the flue gases $= 0.24\ W\ (T - t)$

$$W = \frac{c\ (11a + 8b + 7c + 7d)}{3a + 3c}$$

where c = .8152, a = 6.6, b = 12.6, c = 0.4, d = 80.4, A = 0 (no ash for oil.)

$$\therefore W = \frac{.8152\ (11 \times 6.6 + 8 + 12.6 \times 7 \times 0.4 + 7 \times 80.4)}{3 \times 6.6 + 3 \times 0.4} = 28.7$$

$$\therefore 0.24\ W\ (T - t) = 0.24 \times 28.7\ (743 - 96) = 4355 \text{ B.t.u.}$$

$$\text{Calorific value of fuel} = 14600\,c + 62{,}000\ (H - \frac{O}{8}) + 4000S$$

$$= 14600 \times .8152 + 62{,}000\ (.1101 - \frac{.0692}{8}) + 4000 \times .0055$$

$$= 18{,}202 \text{ B.t.u.}$$

$$\text{Hence lost in flue gases} = \frac{4355}{18{,}202} = 23.9\%.$$

(b) Loss due to moisture formed by burning of hydrogen

$$(9\ H - W)\ [212.9 - t + 970.4 + 0.48\ t_1 - 212)\ ]$$

$$9 \times .1101\ [212.9 - 96 + 970.4 + 0.48\ (743 - 212)\ ] = 1330$$

$$\text{Hence in percentage loss} = \frac{1330}{18202} = 7.3\%$$

(c) Loss due to incomplete combustion.

$$c \times \frac{10150\ CO}{CO_2 + CO} = .8125 \times \frac{10150 \times 0.4}{6.6 + 0.4} = 473 \text{ B.t.u.}$$

$$\text{Hence lost in incomplete combustion} = \frac{473}{18{,}202} = 2.6\%.$$

(d) Loss due to superheated steam used in spraying oil.

$$0.48\ W_1\ (T - t_1) = 0.48 \times .644\ (743 - 378) = 113 \text{ B.t.u.}$$

$$\text{Hence in percentage, loss} = \frac{113}{18202} = 0.6\%$$

(3) Stray losses.

Total heat accounted for

$= 4355 + 1330 + 473 + 113 + 10{,}860 = 17131$

$\therefore$ Stray losses $= 18{,}202 - 17131 = 1071$ B.t.u.

Hence in percentage, stray losses $= \dfrac{1071}{18{,}202} = 5.9\%$.

F. Heat absorbed by boiler.

$= 11.19 \times 970.4 = 10860$ B.t.u.

$\therefore$ efficiency of boiler $= \dfrac{10{,}860}{18{,}202} = 59.7\%$

CHRONOLOGY OF ILLUMINATION.

BY W. R. MORGAN

B. C.

1450 First artificial lighting by "fire-pans," "censers" and "metal braiziers."

1200 Torches used for interior lighting.

500 Oil lamps first used.

238 Earliest mention of coal by the Greek philosopher, Theophrastus.

A. D.

1852 First mention of coal in England; contained in the Saxon Chronicle of the Abbey of Petersborough.

1000 Coal began to replace wood and charcoal.

1180 Coal first mined systematically in England.

1250 Coal became a commercial commodity.

1259 King Henry III granted charter to mine coal in Newcastle.

1272 Coal used in London.

1316 A Royal Proclamation issued forbidding use of coal in London on account of the "noisome smell."

1417 First attempt at street lighting in London. Sir Henry Barton, Mayor, ordained that "lanterns with lights be hanged out on winter evenings between the hours of Hallowtide and Candlemas."

1500 Bazil Valentine discovered muriatic, sulphuric and nitric acids.

1524 Lanterns used for street lighting in Paris.

1541 About this time Paracelsus discovered hydrogen gas.

1560 Special license granted to make charcoal and smelt iron.

1580 Use of coal prohibited by Queen Elizabeth in London while Parliament was in session, because "the health of the knights of the shires might suffer during their abode in the Metropolis."

1609 Val Helmont settled in Brussels and gave the name of "Gas" (from "Geist," meaning ghost or spirit) to the aeriform bodies produced by combustion and by fermentation.

1645 British Royal Society formed (Constitution adopted 1662).

1659 Thomas Shirley investigated a natural gas well in Lancashire, England, and wrote the first description of experiments with natural gas. (Published in the "Transactions of the Royal Society for June, 1667").

1662 The use of coal become so extensive that the sum of £200,000 was raised by means of a "Hearth Tax" imposed on fireplaces by King Charles III.

1662 Robert Boyle ennunciated that statement known as "Boyle's Law."

1670 Dr. Clayton experimented with natural gas at Lancashire, England, and distilled coal to produce gas which he stored and lighted. An account of his experiments was published in the Transactions of the Royal Society for 1739.

1675 Coal distilled for the production of tar.

1676 Boyle's Law confirmed by Mariotte.

1679 A "coal mine" near Ottawa, Ill., U. S. A., mentioned by Father Hennepin, a Jesuit Missionary.

1697 First street lighting ordinance passed in New York City.

1700 Coal exported from England to European countries.

1726 Dr. Stephen Hales published "Vegetable Statics" describing his experiments on the distillation of coal.

1733 Lanterns used for street lighting in Birmingham.

1749 Coal first mined in Richmond Basin, Virginia, U. S. A.

1754 Dr. Joseph Black discovered carbonic acid gas (carbon dioxide).

1755 Coal discovered in Ohio, U. S. A.

1760 Theory of specific heat and of latent heat propounded by Dr. Joseph Black.

1762 Oil lamps (street lamps) first installed in New York City.

1766 A gold medal offered by the French Academy of Science as a prize for the best essay on street lighting; won by Lavoisier.

1767 Hydrogen discovered in water by Henry Cavendish.

1774 Oxygen discovered by Joseph Priestly.

1775 The composition of atmospheric air discovered by Lavoisier.

1776 The water lute (water seal) invented by Priestly.

1781 A patent granted to the Earl of Dundonald for distilling coal—all the products of distillation are mentioned except gas.

1781 The gas holder invented by Lavoisier.

1781 Jean Pierre Minckelers lighted gas distilled from coal as a demonstration to his class in the University of Louvain.

1781. The composition of water discovered by Cavendish.

1789 A description of Lavoisier's gas holder published in England.

1790 Anthracite coal first mined in Pennsylvania.

1792 William Murdoch distilled coal in an iron retort and conducted the gas seventy feet through tinned iron and copper tubes to light his house and grounds at Redruth in Cornwall.

1797 Murdoch lighted with gas his house and offices at Old Cumnock.

1798 Murdoch lighted with gas one of Boulton & Watt's shops at Soho, near Birmingham.

1799 Murdoch invented the "D" slide valve (used in steam engines and gas meters).

1799 Philippe Lebon (in France) patented a "Thermolampe" for the production of gas by distillation from
Sept. wood, coal, etc.

1801 Lebon lighted with gas his house and gardens in the Rue St Dominique, France.

1802 Murdoch gave a public display of gas lighting at
April Soho to celebrate the Peace of Amiens.

1803 Frederick Albert Winsor bagan experimenting with gas apparatus at Hyde Park, London.

1804 Murdoch built gas works and lighted Boulton & Watt's shops at Soho.

1804 Winsor obtained first English patent for gas-making
May apparatus.

1804 Winsor gave a public display of gas lighting at the Lyceum Theatre, London.

1805 Matches invented.

1805 Murdoch built gas works and lighted the cotton mill of Messrs. Phillips & Lee at Manchester; nine hundred burners were supplied.

1805 Samuel Clegg built gas works and lighted the cotton mill of Mr Henry Lodge near Halifax.

1806 Edward Heard patented a process of using lime as a purifier.

18[illegible] David Melville in Newport, Rhode Island, lighted his [illegible] coal gas.

Dec. [illegible] laid in Pall Mall, London, by Winsor.
180[illegible] [illegible] were first gas mains laid in a public street.

Jan. 28. 1807 One side of Pall Mall lighted with gas.

June 12. 1807 Both sides of Pall Mall lighted with gas.

July 12 1807 First meeting of gas stockholders (proposed National Light and Heat Company, London).

Feb. 25 1808 Murdoch read a paper describing the gas installation at Phillips & Lee's Cotton Mill before the Royal Society, and was awarded the Count Rumford Gold Medal.

May 5 1809 Hearing before the House of Commons upon Winsor's application for a charter for the "National Light & Heat Company." He was opposed by Murdoch and Watt.

1809 Clegg wrote a paper on the application of gas lighting to mills and factories and was awarded a silver medal by the Society of Arts.

1809 Wet lime purifier introduced by Clegg in a plant to light Mr. Harris' factory at Coventry.

1810 Application made to Parliament by Winsor and his stockholders to form the "London & Westminster Gas Light & Coke Company."

1810 Act of Incorporation passed by Parliament in favor of the "London & Westminster Gas Light & Coke Company."

April 1812 A Royal Charter granted to the "London & Westminster Gas Light & Coke Company." This was the first gas company formed.

1812 The hydraulic main introduced by Clegg in a plant to light the cotton mills of Ashton Brothers at Hyde.

1813 Clegg became engineer of "The London & Westminster Gas Light & Coke Company."

Mar. 18 1813 David Melville obtained a patent on his apparatus for making coal gas.

Dec. 31 1813 Westminster Bridge lighted with gas for the first time.

April 1814 The oil street lamps of St. Margaret's Parish, Westminster were replaced with gas lamps.

Dec. 9 1815 First gas meter invented by Clegg.

Dec. 28 1815 Gas lighting first proposed for Philadelphia by Mr. James M. Murtie.

1815 First treatise on gas lighting published by Frederick Accum.

1816 Gas lighting introduced in Liverpool, England.

1816 The cylindrical gas holder first appeared. Constructed at the works of the London & Westminster Gas Light & Coke Company under direction of Samuel Clegg.

1816 First Gas Company incorporated in the United States, at Baltimore, Maryland.

1816 Gas lighting first exhibited in Baltimore at Peale's Museum.

1816 Clegg invented the wet meter with revolving drum.

1817 Gas lighting introduced in Manchester, England.

1817 Clegg's wet meter remodelled and improved by John Malam.

1818 Gas lighting introduced in Sheffield, Glasgow and Edinburgh.

June 19 1819 Heard and Gordon obtained a patent for compressing gas in metal drums to furnish a portable supply.

1819 London Portable Gas Company formed.

1819 Gas lighting at Birmingham, Bristol, Paris and Brussels.

1820 Process of Oil Gas Manufacture patented by Taylor and Martineau.

May 1821 Act of Parliament passed, authorizing the erection of Oil Gas Works.

1821-4 Oil Gas Works built at Bristol, Colchester, Dublin, Edinburgh, Hull, Leith, Liverpool, Norwich, Plymouth and Taunton.

1822 Gas Lighting introduced in Munich and Belfast.

1823 Malam patented a process of dry lime purifying.

1823 The Boston (Mass.) Gas Light Company established.

1823 Gas Lighting introduced in New York City.

Jan. 19 1824 Broadmeadow patented the exhauster.

1825 Gas lighting introduced in Amsterdam, Hanover, Ghent, Rotterdam and Rousells.

1825 Governor invented by Samuel Crosley.

1825 New York Gas Light Company established.

1825 Benzole discovered by Faraday.

1825 First gas lamps erected in Brooklyn, New York.

1827 Gas Lighting in Berlin.

1828 First Gas Works in Boston, Mass., built on Hull St.

Jan. 1 1829 First gas lamps in Boston lighted in Dock Square.

1829 Gas lighting introduced in Dresden.

1830 Manhattan Gas Light Company established in New York.

1832 Meters first manufactured in the United States by Samuel Hill in Baltimore, Maryland.

1832 Gas lighting introduced in Louisville, Kentucky.

Mar. 19 1833 A dry meter invented by James Bogardus, an American engraver, was patented by Miles Berry.

1833 Gas lighting introduced in Vienna.

1833 Gas lighting introduced in New Orleans, Louisiana.

Oct. 12 1833 The telescopic holder patented by Hutchinson, engineer of the London Metropolitan Gas Company. This holder was invented in 1824 and described in Creighton's Encyclopedia.

1834 Gas lighting introduced in Havre.

1835 Gas meters manufactured in New York by Young and in 1836 by Samuel Down.

1835 Gas lighting introduced in Caen, Amiens, Bologna, Lyons and St. Petersburg.

1836 Gas lighting introduced in Philadelphia, Pennsylvania, and in Pittsburgh, Pennsylvania.

1838 Gas Lighting introduced in Nantes and in Leipsic.

1840 Gas lighting introduced in Cincinnati, Ohio and in Montreal, Canada.

1840 Meters adopted by the London & Westminster Gas Light & Coke Company.

1841 Gas lighting introduced in Manchester, New Hampshire; and in Sydney, Australia.

1842 Gas lighting introduced in Toronto, Canada.

1843 Gas lighting introduced in Halifax, Nova Scotia.

1843 William Richards made a dry meter with two diaphragms, two slide valves, and a dial, which with minor improvements is the meter in use today.

1844 Gas lighting introduced in Hamburg.

1845 Gas lighting introduced in Madrid.

1846 Gas meters made legal in France.

1846 Gas lighting introduced in St. Louis, Missouri.

1847 Gas lighting introduced in Breslau, Germany; Fall River, Massachusetts, and Newark, New Jersey.

1848 New Haven City. Lighted.
Patterson, N. J. Lighted.
Providence, R. I. Lighted.
Rochester, N. Y. Lighted.
Buffalo, N. Y. Lighted.
Washington, D. C. Lighted.

1849 Quebec, Canada. Lighted.
Norfolk, Va. Lighted
Cleveland, Ohio. Lighted.
Detroit, Michigan. Lighted.
Syracuse, N. Y. Lighted.
Utica, N. Y. Lighted.

1849 A company formed in Boston, Mass., by Mr. George Darracott to manufacture meters.

1850 Chicago, Illinois. Lighted.
Columbus, Ohio. Lighted.
Hartford, Conn. Lighted.
Worcester, Mass. Lighted.
Kingston. Lighted.
1851 Hamilton. Lighted.
Indianapolis, Indiana. Lighted.
Memphis, Tennessee. Lighted.
Buenos Ayres, Argentine Republic. Lighted.
1853 Brockville. Lighted.
Rome. Lighted.
Heidelberg. Lighted.
Milwaukee, Wisconsin. Lighted.
1854 Belleville. Lighted.
Nice. Lighted.
St. Joseph, Missouri. Lighted.
San Francisco, California. Lighted.
Toledo, Ohio. Lighted.
Ottawa, Canada. Lighted.
1855 Vera Cruz. Lighted.
1856 Atlanta, Ga. Lighted.
Melbourne. Lighted.
Warsaw. Lighted.
1857 Scranton, Pa. Lighted.
St. Paul, Minnesota. Lighted.
Copenhagen. Lighted.
1858 Tasmania. Lighted.
1860 Portland, Oregon. Lighted.
1861 Malta. Lighted.
1862 Shanghai. Lighted.
Hong Kong. Lighted.
1863 Smyrna. Lighted.
1864 Alexandria. Lighted.
1865 Bombay. Lighted.
Rio Janiero. Lighted.
Christchurch. Lighted.
1866 Corea. Lighted.
1867 Moscow. Lighted.
Kansas City, Missouri. Lighted.
Los Angeles, California. Lighted.
Oakland, California. Lighted.
1868 Ceylon. Lighted.
Omaha, Nebraska. Lighted.
1869 Stockton, California. Lighted.
1870 Leeds. Lighted.
1871 Yokohama. Lighted.
Minneapolis, Minnesota. Lighted.
1872 Tokyo. Lighted.
Montevideo. Lighted.
1873 Seattle, Washington. Lighted.
1878 Cologne. Lighted.
1879 St. Johns. Lighted.
1885 Tacoma, Washington. Lighted.
1887 Spokane, Washington. Lighted.

TRAIN DISPATCHING BY TELEPHONE.

The appropriations now being prepared in Winnipeg for the work of the Canadian Pacific Railway during 1912 will contain an item for the installation of over 1000 miles of telephone circuits. Such systems have already been successfully used on railroads in the United States, and Canadian tests of the telephone for train dispatching have also proved successful. It will not be long therefore before this method will be used over the entire system of the Canadian Pacific Railway. Almost all the new circuits will be built west of Fort William, the work of equipping the main lines in the east having been virtually completed.

THE INTERNATIONAL ENGINEERING CONGRESS.

To formulate plans for holding an international congress of engineers at San Francisco during the Panama Pacific Exposition in 1915 twenty-seven delegates from nine engineering societies met at the Exposition Building on January 15. At this meeting it was unanimously decided to hold such a meeting and a representative committee was selected to take charge. W. F. Durand, professor of mechanical engineering at Stanford University, was chosen as chairman and Otto Von Geldern as secretary, the other members being H. A. Lardner, C. D. Marx, C. B. Wing, Geo. W. Dickey, S. B. Christy and F. W. Bradley.

The most definite assurance of support was received from the American Institute of Electrical Engineers, whose delegates, H. A. Lardner, George Murphy and S. J. Lisberger, reported that the International Electro-Technical Commission had granted authority to hold an International Electrical Congress in San Francisco during the month of September, 1915, the official meeting of the Commission to be held about the same time. This arrangement will, of course, preclude the American Institute of Electrical Engineers from merging or combining these congresses into a general engineering congress. However, it is greatly interested in this meeting and will do all in its power to co-operate in the arrangements.

The American Society of Mechanical Engineers was represented by Calvin W. Rice, the national secretary; W. F. Durand and E. C. Jones, and assured its hearty co-operation in this work.

The committee from the American Society of Civil Engineers, consisting of A. D. Foote, C. D. Marx and W. A. Cattell, has not yet received definite instructions from the parent society, nor has the American Institute of Mining Engineers nor the Mining and Metallurgical Society.

The Pacific Coast Gas Association, represented by John A. Britton, C. O. G. Miller and Frank A. Leach, Jr., stated that a national meeting of the gas engineers had been arranged. The other organizations, including the American Society for Testing Matereials, Society of Naval Architects and Marine Engineers and Technical Society of the Pacific Coast, have given the matter favorable consideration but have not yet taken definite action.

THE BEE AS AN ENGINEER.

In the construction of the hexagon honey cells of material from her own body, the working bee at once has solved the problem of economy of room, of the lightest possible material of greatest strength, while the dividing wall in each honey case allows the greatest number of workers to continue "on the job." Strips of comb a foot wide and four feet long sustain a weight of thirty or forty pounds of honey, while the comb itself would probably not weigh more than five or six ounces.

ELECTRIC SIGNS IN PARAGUAY.

Electric signs are not needed in Asuncion, Paraguay. Consul Ferris states that the streets are deserted after 7 p. m., and the shop windows are closed by heavy iron shutters.

THE MAN-AND-A-WHEELBARROW.

Ninety-five per cent of the water power locations in the State of California are not made in good faith, nor with the intention of developing energy, according to a statement made recently by Horace T. Jones, special agent for the Conservation Commission and the Conservation Board of Water Power Control. Our own views on this subject may be found on the editorial page, but for the edification of our readers we publish an abstract from Mr. Jones' report.

More than 3000 water power locations have been investigated by the Commission and Board. It is held that valuable water power sites are being held by the "man-and-a-wheelbarrow" method, and as a consequence development of the power resources of the State are retarded.

Filings are made, according to Jones, for the sole purpose of speculation. The locators of power sit on the locations and wait for some company or interest to come along, and then they cinch the victim, who is out for power with the intention of developing it and turning it into commercial uses.

"Development consists largely," said Jones, "of trails and cabins built and surveys. Everything is done by the speculator in water rights that can be done easily and without much outlay.

"The usual custom is to have one or two men, with a wheelbarrow or a pick and shovel, stay on the ground until it can be ascertained whether or not there is any likelihood of a big company or interest coming on to the ground and buying the right, such as it is.

"This is the case in a large number of the filings located at strategic points along the Tuolumne river and its tributaries, for which the purchase price of $652,000 was paid partly to acquire certain water rights belonging to the Ham Hall interests, to control the San Francisco water rights, and also for certain reservoir and dam sites on the upper Tuolumne and the upper tributaries of that stream.

"It was for the purpose of avoiding the difficulty presented to the city of San Francisco that the 'Glavis-Pardee' conservation bill was introduced in the Legislature at the extraordinary session. By this bill the Board of Control of Water Power would have been authorized to sit as a quasi-judicial body to pass upon and adjudicate the use of waters on the various streams of the State."

COAL PRODUCTION OF THE UNITED STATES

Although the production of coal in the United States during 1911 was probably second only to that of the record year, 1910, the year was unsatisfactory to the coal-mining industry. Overproduction and the struggle for trade depressed prices heavily. The record of the anthracite region of Pennsylvania was a notable exception to the general conditions. The shipments of anthracite for the 11 months ended November 30 amounted to 63,838,872 long tons, and the December shipments are estimated at 6,250,000 long tons. This total exceeds the previous high record of 1907 by approximately 3,000,000 tons. The local trade in 1911 amounted to about 2,000,000 long tons, and the colliery consumption to 8,000,000 tons, making the total production for the year close to 80,100,000 long tons, about 4,700,000 long tons over the 1910 output. A part of the increase in production is probably due to the stocking of fuel in anticipation of April 1, 1912, when the present wage agreements terminate, but the market has been absorbing an unusually large tonnage, and the increase is not chiefly artificial.

Much of the bituminous business has been conducted at a loss, and the trade as a whole has been demoralized. The depression of the iron trade has been seriously reflected in the coking-coal regions. It is estimated that the production of coke in 1911 will show a decrease of 20 to 30 per cent from that of 1910. The shutting down of hundreds of coke ovens has added the burden of disposing of a large part of the slack usually consumed by that industry to the other troubles of the bituminous operators.

The total production of bituminous coal in 1911 was probably 3 to 5 per cent below that of 1910. A decrease of 5 per cent means a decline of 25,000,000 short tons, or more than the total coal production of Belgium, the sixth coal-producing country of the world. With this decrease the bituminous output for the year would be between 395,000,000 and 405,000,000 short tons. With the addition of the total anthracite output, the total production of coal for 1911 aggregates between 485,000,000 and 496,000,000 short tons, compared with 501,600,000 short tons in 1910. These estimates are based on statements from leading operators, on the railroad shipments for all but the last few weeks of the year, and on the monthly reports from the blast furnaces.

POWER FROM GARBAGE IN EUROPE.

The generation of electric power from the combustion of garbage on the continent of Europe has been less successful than in England. In general the plants employed are different, the Germans, for instance, using forced draft of 300 to 600 m.m. of water, instead of 60 to 100, as in England. Grates of the bar variety are not used, but troughs into which the material is dumped and through holes in the sides of which the air is blown. Such plants have been built at Wiesbaden, Mickolez, Kiel, Brunn and Frankfort. Continuous grates, however, have been used at Paris, Ixelles, Havre and Rouen, while installations of this kind are under construction at Rotterdam. In plants at St. Petersburg, Zurich and Furth automatic devices for charging the furnaces are used. The new continental plants are designed with a view to power production, the usual guarantee being one pound of steam per pound of refuse. Data regarding some continental plants follows:

Frankfort, six horizontal water tube boilers having 750 square meters of heating surface furnish steam to two 500 h.p. engines, which generated 2,290,143 kw. h., of which the plant itself consumed 377,039, municipal lines used 984,316 kw. h., and the water works plant 928,788 kw. h. Barmen, three vertical fire tube boilers having 420 square meters heating surface, which furnish steam to one 600 h.p. engine, generating 1,400,000 kw. h., of which 300,000 was consumed at the plant, the balance by municipal electric systems. Brunn, two horizontal water tube boilers having 424 square meters heating surface, which furnish steam to two

boilers of 675 h.p.; 809,062 kw. h. were generated, of which 138,615 were consumed by the plant, the balance by the municipal electric system. Frederiksberg, three horizontal water tube boilers having [illegible] square meters heating surface, which supplies steam to two engines of 340 h.p.; 496,187 kw. h. were generated, of which 193,885 were consumed by the plant, 120,869 by the municipal hospital, 2,919 by the water system and 125,514 for private lighting. Zurich, three horizontal water tube boilers of 410 square meters heating surface, which supplied steam to one 220 h.p. engine; 180,347 kw. h. were generated, of which 130,751 was consumed by the plant and 49,596 by shops. At Kiel there are three horizontal water tube boilers having 510 square meters of heating surface, which supply steam to one 80 hp. engine.

GAS AND ELECTRIC EARNINGS IN THE LEAD

Henry L. Doherty & Co., of New York, [illegible] issued a chart and tables showing the [illegible] and decreases of the earnings of the [illegible] electric lines, gas and electric companies [illegible] industrial corporations from 1902 to 1910.

These data show that the gross [illegible] earnings from the gas and electric [illegible] the more rapidly, and that they [illegible] ted in their rate of increase by the [illegible] even in 1907 and 1908. Gas and [illegible] the eight years under review, experienced [illegible] in net earnings, while the [illegible] railway properties are the [illegible] no decrease in gross earnings [illegible] the railways and industrials [illegible] to the most violent fluctuations [illegible] idly in the years of panic [illegible] 1907-8.

It is noted that [illegible] earnings of gas and [illegible] 1908 than in any [illegible] net earnings were [illegible] and explanation is [illegible] the fact that many [illegible] ened by the panic [illegible] penditures in that period [illegible] declared that earnings [illegible] trials fluctuate in common [illegible] upon freight [illegible] times forcing drastic economies in [illegible] maintenance supplies, while electric railways [illegible] all their revenue from passenger [illegible] them is very little affected in times of stress.

Another feature worthy of note in this interesting comparison is that the gross earnings of all properties under review have shown a greater percentage of increase than that of the net earnings. Probably this is due largely to the fact that the cost of materials or labor or both, have increased more rapidly than prices have enhanced. This is particularly interesting in view of the general downward trend of prices for gas and electric service in the last ten years. The net profits are seemingly coming from a constant increase in the volume of sales, rather than, as formerly, from small sales and larger profits.

POWER FROM LAKE GENEVA.

Two suggestions have been made for exploiting the Lake of Geneva for the benefit of Paris, one being to convey its water through an aqueduct to Paris and the other to utilize the water power of the upper Rhone at its outflow from the lake.

According to the latter it is proposed to build a [illegible] embankment at Genissiat, which is to convert the whole valley of the upper Rhone as far as Geneva into an artificial lake 23 kilometers long, with a capacity of [illegible] 50,000,000 cubic meters. The head of 67-69 [illegible] thus available would supply up to 246,500 [illegible] watts, while the number of kilowatt hours available during a year would be equivalent to the energy [illegible] by the combustion of 1,500,000 tons of [illegible]. The power house at the foot of the embankment is to contain 24 units of 10,000 kilowatts [illegible] of 15,000 kilowatts, and three-phase trans[illegible] at 120,000 volts (possibly 150,000 volts) [illegible] adopted, the current being generated at 12,-[illegible] volts and transformed up in a transformer house [illegible] 80 feet long. The Francis turbines are to work [illegible] of 250 revolutions per minute, and the con[illegible] current exciter machines (750 kilowatts, 160 [illegible] are to be operated by vertical turbines. Each [illegible] generator set is to be quite self contained. The [illegible] high tension transmission lines from Genissiat to [illegible] to convey no less than 80,000 to 100,000 [illegible]. They are to be divided into two groups, [illegible] different paths, each line to be subdivided [illegible] switches into sections of 100 kilometers [illegible] lines permitting any injured section to [illegible] without interfering with the operation of the [illegible]. Lines are to consist of aluminum lines ar[illegible] feet apart and carried by steel towers 65 [illegible] in height. A thick galvanized steel protective [illegible] on top of the lines.

OIL PRODUCTION OF CALIFORNIA.

The total oil production of the State of California [illegible] 1911 was 78,845,082 barrels, according to figures [illegible] compiled by R. W. Dallas, manager of the California [illegible] of the Independent Oil Producers' [illegible]. This is an increase over 1910 of 5,834,522 [illegible] or about 8 per cent. The total production for 1910 was 73,010,560 barrels. Midway field leads with [illegible] production of 20,000,000 barrels, and Coalinga comes [illegible].

TAMPICO, MEXICO, ELECTRIC ACTIVITY.

Plans are said to have been completed for replac[illegible] with electric cars, for enlarging one [illegible] light plants, and for utilizing the water [illegible] of this region for electric power.

[illegible] of the new administration in Mexico is [illegible] of confidence in [illegible] public hydroelectric [illegible] and the reopening of [illegible] operations is of material aid in [illegible] of electrical power.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
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A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Chronology of Illumination

Since the beginning of creation man has yearned and longed for the light. Down through the ages beginning with those early days of which we read that "Darkness was upon the face of the deep and the spirit of God moved upon the waters and God said 'let there be light,'" man has steadfastly yearned and longed for its complete fulfillment. The instinctive desire of the new-born babe to turn its eyes toward the glistening ray which perchance throws itself across the darkened bed-chamber is the most striking example of this human trait.

Even the most dissolute of human beings have felt its charms and we can almost imagine that the ruling passion uppermost in the thoughts of the degenerate old Roman Emperor, Nero, as he quietly fiddled away in the presence of the burning of Rome which he himself had planned, was not that of "There'll be a hot time in the old town tonight," but rather that inborn something, that something which moves us all no matter how low we may have fallen, namely "search for the light."

We of modern times can scarcely realize what the advance of ingenuity and invention has done for the solution of this burning question of the ages. As, in the evening we enter the brilliantly lighted metropolis every street with its well designed electrolier or Welsbach, every ballroom with its glittering bespangled decorations should forcefully contrast itself with the dingy, crime-lurking streets of the days of yore and with the ballroom of yesterday suggestive more of spooks than the fairy-winged beauties of today.

Elsewhere in these columns is to be found a chronology of illumination by W. R. Morgan which sets forth the interesting facts or mile posts, as it were, in the advance of the art of illumination. Most striking is the contrast of the slow progress in the art for centuries upon centuries as compared with that of the past two decades. Even the far famed "ten league boots" could not follow the recent comet-like progress of this art across the horizon of human progress.

The human race, like the philosopher of old with his lantern lighted in broad daylight, is ever yearning to be raised to a higher plane, and though its efforts may be as futile as those of Diogenes in his search for an honest man, yet the very symbolism of light itself so forcefully emphasized by the modern improvement in illumination is unquestionably working upon the unconscious psychological side of man a deep felt influence.

Oil Burners

The subject of oil burners has been one of considerable agitation of late both in the columns of this Journal and elsewhere. In this issue will be found an article on "Drilling Boilers in the California Oil Fields," and in its conclusion the author, A. S. Menzin, has given interesting details of a home-made burner which seems to have considerable popularity in the oil producing localities of the State.

The remarkable efficiency with which such crude mechanisms perform their purpose proves more thor-

oughly the idea now so well recognized among engineers, that after all the question of the burner is not one of paramount importance. The actual setting of the boiler and particularly the arrangement of the furnace with its baffling walls seem to be the crucial points in deciding the efficiency or non-efficiency of installations of this sort.

Not many months ago the readers of this Journal were treated to the interesting details of a test on the Parker boilers installed in the Fruitville Plant of the Southern Pacific Company. These boilers showed under a most rigid test the remarkable efficiency of 83.7 per cent. It is the usual practice to neglect in the compilation of boiler efficiency the heat stored in the steam used for the atomization of the oil and also the heat required to superheat this steam to the temperature of the out-going chimney gases. In a word, the efficiency of the boiler is generally taken from the standpoint of evaporative proficiency rather than the net result after allowing for this energy used in the atomization of the oil.

Four boilers of the Parker type have just been installed and put in operation at Station C of the Pacific Gas & Electric Company in Oakland. These boilers are to be used to operate a recently installed 12,000 kilowatt Curtis turbine. It is planned within the near future to subject the entire boiler and turbine installation to the most rigid tests. Hitherto but a single boiler has been tested in trials of this sort, but in the proposed run the plant as a whole will be put through the ordeal.

Engineers are looking forward with much expectancy to the results that may be brought out in this test. Undoubtedly it will add much to our knowledge in this phase of engineering on the Coast. It will be interesting to follow the working of the complete power plant, and especially to note the question, not only of the boiler evaporation, but also the efficiency of the entire plant, taking into account every loss which we are able to completely determine.

At Station A of the Pacific Gas & Electric Company in San Francisco has been recently installed the largest turbo-generator on the Coast. This generator has a capacity of 15,000 kilowatts and is of the Curtis type, with six stages of steam expansion. The test upon this installation will also be of much practical importance for Coast conditions. It will be interesting to note the economy of such large units. The operation of units of this magnitude upon the gigantic network of hydroelectric installations of the Pacific Gas & Electric Company will also be of much interest and undoubtedly there will be developed in the forthcoming test some new and interesting ideas.

The Man-and-a-Wheelbarrow

"The Man-and-a-Wheelbarrow," the title of an article appearing elsewhere in these columns, strikes once again at the hardy prospector who has done so much for the development of our great Western empire. It is indeed true that the locator of a valuable water right often is unable to do more than improve his project by the wheelbarrow method. Only he who has lived in the cabins of the prospector, where either mining or hydroelectric development of our unknown natural resources was being undertaken, can appreciate what the rugged life and stay-with-it-ive qualities of this type of citizen really are.

It is stated in the article above referred to that 95 per cent of the hydroelectric power sites are never actually undertaken. Undoubtedly it might with truth be said that 99 per cent of the mining prospects are never actually developed and yet the history of mining bears record to the fact that only through years of toil on the part of the prospector have many of our great mining projects ultimately succeeded. No one knows of the days of weariness and discouragement, yet unceasing efforts of this class of men.

It is true that if some kind god would drop down from heaven, create the market for power, bring the money for its development and all the other accessories necessary for the complete project, it would be idle for us for a minute to defend the prospector in his work. Human conditions are such, however, that the prospector who through the sweat of his brow climbs over the mountains, runs down his power site, stays with it year after year in the face of every adverse circumstance is entitled to be rewarded for his service in sufficient amount to give him a life competency.

From childhood we have learned that "the mills of the gods grind slow, and exceedingly small." The progress of invention, the history of mining, and above all, hydroelectric development are monuments to the truth of this ancient adage. We turn to the records of the patent office and find a million patents have been issued. Yet patents that are commercially possible only run into the thousands. Should we then because of this small showing, announce to the world that ninety-five per cent of the inventors are not working in good faith? Again, we turn to the mining records and here locations are made literally by the millions. We go out into the mineral districts and find hills gophered from end to end by these so-called speculative prospectors, and yet the number of paying mines but runs into the hundreds. Must we, then, condemn this great body of industrious mining prospectors and say to them, though they have grown gray haired in their fruitless industry, that ninety-nine per cent are not acting in good faith? Finally, we turn to the water power locator. The record of our western states show volumes of applications and yet the two decades of hydroelectric advance have witnessed scarcely a hundred large water power plants. Shall we then say to the water power prospectors who have spent years of search in a wilderness of mountains, wandering over foot-blistering rocks and dizzy cliffs that because years must still elapse before a nation's development can justify a reward for a life of earnest endeavor, they must now be classed as not acting in good faith?

No, brothers, rest soft and low. Though upstarts of [illegible] mudslingings, jealousies and muckraking may at [illegible] dim your chances, the all powerful force of justice will eventally bring sure reward.

PERSONALS.

B. F. Kierulff of Los Angeles was a recent San Francisco visitor.

C. L. Cory has returned to his San Francisco office from a Northwestern trip.

F. B. Gleason of the Western Electric Company was at Los Angeles during the past week.

W. D. Thomas, who is in the electrical supply business at Petaluma, was a recent San Francisco visitor.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is visiting the Seattle office.

J. A. Herr, representing the Sprague Electric Company, left during the past week for Southern California.

W. A. Doble, former head of the Abner Doble Company, is now chief engineer of the Pelton Water Wheel Company.

J. A. Ulmer, head of the J. A. Ulmer Machinery Company, arrived at San Francisco from Porterville during the past week.

A. C. Balch, general manager of the Pacific Light & Power Company of Los Angeles, was a recent arrival at San Francisco.

M. F. Steel, of the Benjamin Electric Company's Pacific Coast agency, is in Southern California on an extended selling trip.

John Coffee Hays, general manager of the Mt. Whitney Power Company, with headquarters at Visalia, is at San Francisco.

C. O. Poole, of the electrical engineering firm of Manifold & Poole, with offices at Los Angeles, has been spending a few days at San Francisco.

Ray M. Hart, of Coeur d'Alene, Idaho, who is connected with the construction and operation of electric traction lines in Idaho and Washington, is at San Francisco.

A. E. Barlow, who represents the American Ever-Ready Company in the Pacific Northwest, with headquarters at Seattle, spent the past week at San Francisco.

H. L. Jackman, general manager of the Western States Gas & Electric Company, with headquarters at Eureka, has arrived at San Francisco, after completing an Eastern trip.

F. A. Somers, of the sales force of the Westinghouse Electric & Manufacturing Company's San Francisco office, is traveling through the interior of the State of California.

A. J. Wishon, general manager of the San Joaquin Light & Power Corporations, has arrived at San Francisco from Fresno, accompanied by his assistant, E. B. Walthall.

H. E. Sanderson, the newly appointed Jovian Statesman for Northern California, is expected to do a great deal of much-needed "boosting" for the order this year.

R. F. Oakes, president of the American Ever-Ready Company, has returned to factory No. 8, at San Francisco, after visiting Los Angeles, where the company has a branch.

Ralph Bennett, who has been connected with the engineering staff of the Great Western Power Company for some time, has gone to Los Angeles, where he will maintain headquarters in the future.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, of Chicago, has returned to San Francisco after a successful business tour of Southern California.

M. H. French of Los Angeles, who has the contract for the transmission line construction of the Southern Sierra Power Company, was a recent San Francisco visitor en route to Butte, Montana.

Thomas I. Stacey, vice-president of the Electric Appliance Company of Chicago, has just arrived at San Francisco after visiting C. C. Hillis, manager of the company's San Francisco branch. Mr. Stacey will make a tour of the Hawaiian Islands.

John S. Eastwood, consulting engineer, has returned to San Francisco from Oregon .

Samuel L. Napthally, general manager of the Great Western Power Company, has returned to San Francisco from Portland.

Elgin O. Stoddard of C. C. Moore & Co. has returned from Honolulu, where he went in connection with securing a big electric pumping equipment contract for the Pearl Harbor drydock.

E. J. Dwyer, who has been manager of the Holabird Electric Company, of Seattle, for several years past, has just come to San Francisco and joined the sales corps of the Holabird-Reynolds Company.

Frank Marcy, who was formerly district manager for the Allis-Chalmers Company at Salt Lake City, and who is now holding a similar position at the same place with the Mine & Smelter Company, is a San Francisco visitor.

Bion J. Arnold, the Eastern traction expert, arrived at San Francisco during the past week, with a corps of assistants who will collect data, and begin his investigations into the city's street railway problems. His remuneration is to be $250 a day.

Hamilton F. Gronen, chief engineer of the Nisqually power plant, is in Milwaukee inspecting and making tests on the 8,000-h.p. turbines and generators for the City of Tacoma's light plant. The turbines and generators are being built at the West Allis shops of the Allis-Chalmers Company.

Elam Miller, commercial engineer for the Pacific Telephone and Telegraph Company, who resigned in order to accept a position with the American Telephone and Telegraph Company, has gone to New York to assume his duties. C. P. Morrill, commercial supervisor for the first-named company at San Francsco, has been promoted to fill the vacancy.

A. I. E. E. MEETING NOTICES.

At the January 16th meeting of the Portland Section, A. I. E. E., J. R. Thompson presented a paper entitled "When Does It Pay to Develop Water Power?"

The San Francisco Section, A. I. E. E., will meet at 8 p. m. on January 26th at the Home Telephone Company's building, where Otto A. Falch, engineer with the Sierra and San Francisco Power Company, will present a paper on the "Design of High-Tension Transmission Lines."

The Los Angeles Section, A. I. E. E., will hold its February meeting on the second or third Tuesday of the month and will discuss papers on "Oil Gas Manufacture," by D. J. Young, superintendent of manufacture for the Los Angeles Gas and Electric Corporation, and "Gas Producer Plants," by O. S. Ensign of the United States Reclamation Service.

ELECTRICAL LEAGUE AT LOS ANGELES.

At the Electrical Lunch Club at Los Angeles on January 11th a new organization was perfected and the name changed to the Electrical League. New by-laws and rules were presented for adoption and it was decided to hold weekly meetings instead of monthly meetings. More complete details will be published later.

PACIFIC COAST A. I. E. E. CONVENTION.

The executive committee of the Portland Section of the American Institute of Electrical Engineers has decided to hold the Pacific Coast convention April 16th to 20th, inclusive, and has also decided upon the Hotel Multnomah as the headquarters.

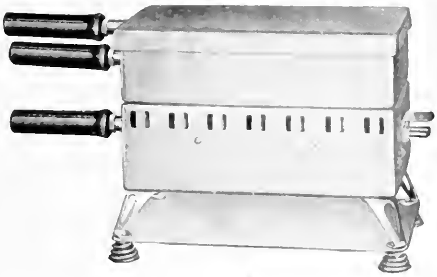
INDUSTRIAL

RADIANT GRILL.

The General Electric radiant grill provides one of the most flexible and useful cooking devices ever designed for the table, nursery or sick-room or for us wherever desired, within reach of a lamp socket. It can be used for toasting, broiling, frying and boiling.

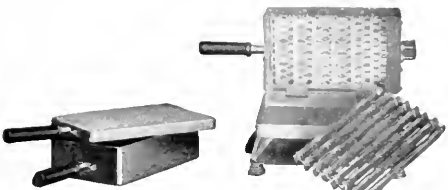
In toasting, the slices of bread may be placed either above or below the radiant heater coil of Calorite wire. Protective gratings on both sides of the heater coil prevent the substance cooked from coming in contact with the coil.

The lowermost receptacle is the broiler pan. This is provided with a corrugated metal rack, the design of which permits of the steady regulation of the distance of the food from the heater coil. The rack lies on the bottom of the broiler pan; in one position it holds the food away from the heater coil, and by simply turning the rack over, the food is brought closer to the coil.



Radiant Electric Grill Assembled

The uppermost receptacle is the stew pan, which is provided with a cover which can be turned over and used as a frying pan or a griddle. This cover is made of aluminum and therefore does not require the use of grease for making pancakes.



Radiant Grill Showing Parts.

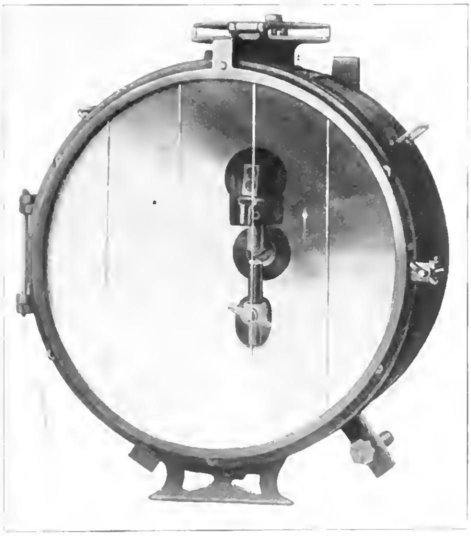
The top of the stove containing the heater coil is hinged to the broiler pan. The hinges are of special design permitting easy access to the pan below, or allowing the top of the stove to be entirely removed from off the broiler pan for the convenient handling of the latter.

The entire device is finished in polished nickel and its neat appearance makes it a pleasing addition to the table, while its capacity of 600 watts adapts it for use on the ordinary lighting circuit. A specially important feature is the ease with which it can be kept clean.

METALLIC FLAME ARC HEADLIGHTS.

The rapid growth of the use of metallic flame arc lamps has led to their adoption in another field formerly served by the carbon lamps exclusively, that of headlights on interurban electric cars. Such cars require a thoroughly reliable source giving a large volume of penetrating light. These characteristics coupled with great economy of operation are possessed to a marked degree by the metallic flame arc headlights now being put on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

An additional advantageous feature of these lamps is the fact that by reversing the direction of current through the electrodes by means of the plugs a dim greenish light is obtained which is suitable for use when the car is traversing city streets



Improved Headlight

Metallic flame arcs give much more light for the same expenditure of energy than do either carbon arcs or incandescents and furthermore the light emitted is very penetrating thus adapting them particularly for headlight service.

The lamps are designed for use only on direct current circuits, the voltage of which is above 120. They take 4 amperes and approximately 70 volts at the arc.

To reduce the line voltage to that required at the lamp terminals, and also for the purpose of steadying the arc, there is supplied a resistor consisting of grooved porcelain spools, around which a special wire is wound, all closed in a readily removable case. The wire is made of a non-corrosive alloy that will not be affected by continual changes in temperature, and the resistance is such that it can be readily adjusted to give the proper voltage at the lamp terminals with a range of line voltage from 325 to 600.

Essentially, the metallic flame arc headlight consists of a simple, rugged feeding mechanism (enclosed within a weatherproof case) arranged to so feed a metallic electrode that it will maintain a steady arc. Sheet iron is used in forming the body of the case, and the case rim and the door frame are brass castings. A hooded chimney is provided at the top, and a hinged door at the bottom for inserting the negative electrode. Supporting brackets, provided with hooks, fasten the headlight to a car dashboard. The hooks engage over a loop of strap metal, which should be provided on the dashboard of the car or they may hang on the upper edge of the dashboard. Two adjusting screws, which have rubber-

covered bumpers arranged to bear against the dashboard, are attached to extensions at the bottom of the case. These are used for properly directing the beam of light.

The glass front consists either of flat sections, in which case a parabolic reflector of spun brass, heavily nickeled and highly polished, is furnished, or of a semaphore lens. In both styles the rays projected from the headlight are parallel.

A feeding mechanism of the simplest possible design has been developed for this headlight. It consists of a solenoid with its winding in series with the arc, which, through a positively acting clutch and a series of levers, feeds the electrode. The lower or negative electrode is attached to a lever and is drawn toward or away from the stationary positive electrode by the movement of the solenoid and clutch. The clutch engages an auxiliary rod attached to an operating lever. No dashpot is required. By turning a screw, the arc length can be adjusted.

The electrodes are similar in composition to those used in Westinghouse multiple and multiple-series metallic arc lamps. The negative one is about 5 inches long and ½ inch in diameter and is composed of certain metallic oxides. The positive one is a metallic block. Negative electrodes have a life of 70 to 80 hours and the positive electrode will last about 500 hours. They can be changed without removing the mechanism from the case.

A particularly efficient application of this lamp is its installation on steam locomotives when used in connection with the small turbo-generators train sets.

NEW BENJAMIN LAMP GRIP.

The Benjamin Electric Manufacturing Company of Chicago is placing upon the market a new device which will play an important part in the prevention of lamp breakage, accidents and general inconvenience due to the loosening of lamps in places where there is any considerable vibration, such as factories, steam cars, street cars, shops, etc.

The device consists of a spring collar, operating through slots in the threaded socket shell and engaging the lamp base with sufficient force to prevent it from loosening and falling out.

New Benjamin Spring Collar.

Its advantages are apparent. It prevents lights from going out unnecessarily, saves time in readjusting them when they work loose, as is often the case during the day; also prevents accidents in dangerous quarters where the lamp might strike the workmen.

The company is prepared to supply this lamp grip with its entire line of reflector sockets covering the range of lamps from 25 to 500-watt, and is now adapting it to its other lighting units.

PELTON-DOBLE COMBINATION.

An announcement of interest to the engineering world is that of the absorption by the Pelton Water Wheel Company, of San Francisco and New York, of the entire rights, including patents, goodwill, patterns, etc., of the Doble water wheel business, formerly conducted by the Abner Doble Company of San Francisco.

W. A. Doble, former head of the Abner Doble Company, goes to the Pelton Water Wheel Company as its chief engineer, vice Geo. J. Henry, Jr., who, until recently, occupied that position.

A particularly strong combination is thus formed, as these companies have for years been recognized as the pioneers in the development of hydroelectric engineering, and the merged experience of the two companies, together with patents now controlled by the Pelton Water Wheel Company, forms an organization with the best possible facilities to cope with any problems in the field of hydraulic engineering.

In addition to Pelton and Doble tangential water wheels, the Pelton Water Wheel Company manufactures the Pelton Francis turbine, adapted for medium heads and large powers, besides a line of high grade centrifugal and turbine pumps. Pelton oil pressure governors are also a feature of this company's product.

The Atlantic department of the Company, with offices in New York City, has recently completed large and well equipped machine shops in Harrisburg, Pa., the two points of manufacture thus facilitating deliveries to all parts of the world.

ELECTRICAL CONTRACTORS' NOTES.

Bids are being called for electric work on the Sacramento Armory.

The General Electric Construction Company was awarded the wiring for a five-story apartment and stores at Sixteenth and Valencia streets at $3,500.

The John G. Sutton Company received the contract for wiring St. Luke's Hospital at $15,250, also the contract for the power plant, and heating and ventilating equipment at $25,600.

The cost of building in San Francisco for the year 1911 was $24,431,268, against $22,873,912 for 1910. Oakland, $7,118,197 in 1911, $7,078,635 in 1910; Los Angeles, $23,004,185 in 1911, $21,684,100 in 1910.

The Pacific Gas and Electric Company has commissioned Architect E. C. Heminway to prepare plans for a five-story class A building in Sacramento, the cost of which will be about $100,000.

The electric work for the Girls' High School was awarded to the Standard Electric Company for the sum of $5,497. Other bids were: Butte, $5,737; Sutton, $6,280; Central, $6,290; General Electric Construction Company, $6,467; McFell, $6,695; Turner, $6,700; National, $7,800.

TRADE NOTES.

The Allis-Chalmers Company has sold the Salt River Valley Consumers' Association of Phoenix, Ariz., twelve 500-kw. transformers for the distribution of power generated at the electric generating plant supplied from the great Roosevelt dam.

Kalenborn & Pahl, electrical contractors, San Francisco, report the completion of a difficult job of submarine cable work for the United States Government which has recently connected Angel Island with an 11,000 volt power cable to the mainland at Tiburon across Raccoon Straits. They also have just finished the installation of a 100 h.p. motor-pumping plant near Woodland and are at work on another plant of like size for the Oulton Land Company on Twitchell Island.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—International Fuse Lighter & Electric Mfg. Company has been incorporated for $1,000,000, by H. H. Mears, D. M. Potter, J. Auchell, W. W. Bearman and F. Fette.

LOS ANGELES, CAL.—Central California Gas Company has been incorporated for $100,000 capital stock, with directors C. S. Forney, J. H. Straede, De W. S. Childress, F. R. Miller and H. B. Landes.

SAN DIEGO, CAL.—Vulcan Water Company has incorporated with capital stock of $1,000,000. Will operate in all kinds of irrigation and water supply enterprises. Incorporators are Wm. G. Henshaw, Ed Fletcher and others.

TRANSMISSION.

LINDSAY, CAL.—The Tulare County Power Company, through Purchasing Agent Holley of Lindsay, Cal. has given an order for Locke insulators to equip 150 miles of transmission line to Pierson, Roeding & Co., and 110 tons of wire to the National Conduit & Cable Company.

RED BLUFF, CAL.—The Oro Water, Light & Power Company, operating in Butte County, and with head offices in San Francisco, has purchased the interests of the Butte and Tehama Power & Irrigation Company and the Sierra Irrigation Company. The Oro Company has been operating in and about Oroville for many years, and lately has been preparing to erect additional plants and extend its lines to Sacramento and on to San Francisco bay. A large generating plant on Mill Creek will be erected at once.

OROVILLE, CAL.—A force of surveyors in the employ of the Oro Electric Corporation, has located its camp near Central House, south of this city. A course to be followed by the power line from Humbug Valley in Plumas County is being surveyed. During the present year the erection of a power plant at Humbug Valley will be started. The power line will leave the mountains at Pentz, about 15 miles north of this city, will come here and then on to Marysville and Sacramento, whence it will continue to San Francisco.

ILLUMINATION.

CASTLE ROCK, WASH.—The Castle Rock Coal, Light & Power Company will build an electric lighting system and power system here.

OCEANSIDE, CAL.—The Oceanside Electric Company has been notified of the expiration of its three years' lighting contract with the city.

EMMETT, IDAHO.—The report that the Idaho-Oregon Light & Power Company will build a dam across the Payette River, near here, at a cost of $250,000 is erroneous.

PASADENA, CAL.—C. W. Koiner, general manager of the municipal lighting department, was given permission to spend $3090 on operating supplies and construction material.

LOS ANGELES, CAL.—A gas plant is now being erected at Bell Flower Acres. Mains will be laid in a short time and gas will be supplied to the entire tract for heating and lighting purposes.

ROSEVILLE, CAL.—At the meeting of the Roseville Board of Trustees bids were called for electric energy for a period of five years. Only one bid, that of the Great Western Power Company, was offered. The terms of the resolution of the board were accepted and the price set at 1½c per kw. hour.

TACOMA, WASH.—An announcement was made by District Manager R. T. Laffin of the Stone & Webster interests in the Northwest, of the consolidation of the various companies operating west of the Cascades under one general management. The new company is to be known as the Puget Sound Traction, Light & Power Company.

MARTINEZ, CAL.—The Town Trustees by a vote of 3 to 2 have rejected the offer of the Great Western Power Company to pay the 2 per cent on the gross earnings of the company for light, heat and power in this city. The trustees ordered that the suit pending in the Superior Court to enjoin the company from proceeding with work in the town be carried to the Supreme Court.

TRANSPORTATION.

LOS ANGELES, CAL.—Mayor Alexander vetoed the resolution adopted by the City Council giving the Pacific Electric permission to electrify the Santa Monica Air Line.

WILLOWS, CAL.—A franchise has been granted by the Corning trustees to F. H. Ridley for a mono-rail railroad, proposed to be built from Paskenta to Red Bluff via Corning.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has been granted a franchise to operate for a period of forty years, a street railway on certain streets of the city.

MONTEREY, CAL.—An electric railway is to be built from Pacific Grove to Pebble Beach. A clearing of the right of way through 17-mile reservation from Lake Majela, the end of the Southern Pacific road, is now being made. The road is to be built by the Pacific Improvement Company.

SANTA CLARA, CAL.—James P. Sex, representing the Peninsular Railway Company, appeared before the Board in regard to the proposed franchise for a railroad. The franchise is to run 50 years. The board decided to advertise the franchise for sale, the bids to be opened February 12th.

VALLEJO, CAL.—President T. T. C. Gregory of the Vallejo & Northern Electric Railway Company, which proposes to join Vallejo and Sacramento with an electric line, announces that bids will be opened in the San Francisco office in the near future for the terminal work, which is to be performed in this city. The job will consist mostly of grading.

OAKLAND, CAL.—As the result of an active campaign started several months ago by the members of the Elmhurst Board of Trade the Key Route has agreed to extend the Key Route Twelfth street extension from Thirteenth avenue and East Fourteenth street to the eastern limit of Elmhurst. This change will take place within the next two weeks, or as soon as the new cars are ready.

SAN JOSE, CAL.—Five miles of new electric line connecting Meridian Corners and Santa Clara will be built at once by the Peninsula Railway Company. The road will connect the company's line at the former place and the Southern Pacific depot in the latter city. Work on the new line, which will eventually be a part of a system connecting San Jose and San Francisco on the west side of the bay, has begun at Meridian Corners and will be pressed rapidly.

SAN FRANCISCO, CAL.—A resolution has been drafted for presentation to the Supervisors for extending the permit under which the old Geary Street Railway Company can [illegible] days from January 16. The present permit [illegible] on that date. Commissioner Laumeister reported that the plans for the new cars for which bids are to be

asked will be ready in a few days, but probably will be referred to Bion J. Arnold, the Eastern expert, before advertising for bids.

SEDRO-WOOLEY, WASH.—The Whatcom County Railway & Light Company, Bellingham, is extending interurban service to this place and will construct a substation, depot and shipping facilities here.

SEATTLE, WASH.—A permit has been granted by the Board of Public Works to the Seattle Electric Company to install an additional curve at First avenue and Yesler way and to double-track Twelfth avenue South, between Lane and Norman streets.

SAN FRANCISCO, CAL.—Paul Shoup of Los Angeles, vice-president of the Pacific Electric road system in Southern California, an adjunct of the Southern Pacific, is at the Palace. Shoup is in the city conferring with President Sproule of the latter company regarding plans for extending the electric system in many directions during this year. Recently the electric road company authorized a stock issue of $100,000,000 and a bond issue of like amount. Money from the sale of these new bonds will be used for new lines from time to time, a definite start being made this year.

TELEPHONE AND TELEGRAPH.

KENNEWICK, WASH.—The Kennewick Valley Telephone Company has commenced work on the installation of new central energy system, to take the place of the present system.

WATSONVILLE, CAL.—The Carlton District Telephone Company has organized and elected officers. Work has commenced on the erection of a line to serve the residents in that district. Walter E. Pecham is president.

CHICO, CAL.—The first step toward the ultimate lighting of the downtown business streets with electroliers was taken when the members of the Board of Trustees adopted a design of electroliers submitted by John Waterland.

SANGER, CAL.—The application of the Sanger Telephone Company for a 25-year franchise for a telephone system in this city was heard and the ordinance granted. The franchise is to be advertised for bids and granted to the highest bidder.

HOQUIAM, WASH.—Two new rural telephone lines are now being promoted and indications are that one of them will be built within the next few months. The proposed lines are to give Pacific Beach and Noclips connections with Hoquiam.

VALE, ORE.—Juntura will have telephone connections with Boulah within the next 30 days, as a company of the people of that section has formed for the installation of a line for a distance of 12 miles. Persons backing the enterprise are Dan Gilkey, R. L. Scott, D. F. Murphy.

TULARE, CAL.—At the annual meeting of the Tulare Home Telephone Company the Board of Directors were elected as follows: T. D. Blodgett, M. G. Cottle, Sol Rosenthal, S. B. Anderson, and G. C. Harris. The officers are G. C. Harris, president; T. L. Blodgett, vice-president; Sol Rosenthal, secretary. The company is contemplating a large increase in the farmers' lines. All lines outside of the city limits must be erected at the expense of the farmers, but the company gives them a rate of 50c per month. The company is now furnishing 725 phones.

SAN FRANCISCO, CAL.—Both the Pacific Telephone & Telegraph Company and the Bay Cities Home Telephone Company have each signified their willingness to carry out the consolidation which has been talked of for some time. The Bay Cities Telephone Company has filed with the Board of Supervisors a draft of an ordinance permitting the consolidation, together with a petition for its enactment signed by Robert A. Frick, vice-president, and G. B. Ocheltree, secretary of that company. Henry T. Scott of the Pacific Telephone & Telegraph Company has stated that the consolidation would be effected if the people wished it. He does not exactly say that the terms have been determined, but the companies are near enough together to prevent any failure of the negotiations. The same is true of the situation in Berkeley and Oakland, the only other places where the Home company is operating in the bay region. Scott said that he thought there should be no objection to the consolidation as long as the Supervisors had the rate-making power, and stated that the service of the Pacific company, which has been improved since the competition, would be continued at its present level of efficiency. The proposal made to the Board is that in addition to the 600 free telephones given the city it shall have the free use of two of the conduits of the Home company for fire and police lines; and that the Pacific company "will be allowed, for rate fixing purposes, a return only on such portion of the property acquired from the other company as may be reasonably useful and necessary in the operation of its system." It is also stated that the form of ordinance presented was drafted by the San Francisco Chamber of Commerce. In the petition signed by Frick and Ocheltree are the following paragraphs: "During the eighteen months in which this company has operated the Home system in San Francisco, notwithstanding that excellent service has been given, the difficulty in securing subscribers, and the repeatedly expressed views of the citizens of San Francisco, have made it clear that the people of this city are strongly opposed to the maintenance of two telephone systems, and greatly desire that they be consolidated. In response to this public demand, this company and the Pacific Telephone & Telegraph Company, with the permission and approval of your honorable Board, are ready to merge their respective telephone systems in this city. As the Pacific Telephone & Telegraph Company covers the entire Pacific Coast this consolidation of the systems in San Francisco can only be made by means of a transfer of the property of this company to the Pacific Telephone & Telegraph Company."

WATERWORKS.

CARLTON, ORE.—Carlton will hold an election February 5th to vote bonds amounting to $40,000 for the construction of the proposed gravity water system.

BEAVERTON, ORE.—Engineers have estimated that an ample supply of water can be obtained by Beaverton for $10,000. The plan is to sink wells and pump the water by electric power.

ELLENSBURG, WASH.—The City Council has awarded the contract for the construction of the $150,000 municipal waterworks and distributing system to the International Contract Company of Seattle.

SPOKANE, WASH.—Approximately $2,000,000 worth of stock is being issued to stockholders of the Washington Water Power Company. The money is to be used for extensions and improvements for the entire system of the company, and for work at Long Lake, for power plants and street paving.

MODESTO, CAL.—This city will soon vote on a bond issue of $82,500 for the improvement of the municipal water system. The plans of the council mean the entire rebuilding of the system. The changes and additions proposed include new mains to cost $41,724; additional hydrants, $3,141; additions and changes in the pumping plants including the purchase of the Cressey pump at the old gas works, extensive improvements at the Eighth and Seventeenth streets and Wisecraver stations, $22,000; other improvements, including two tanks of a capacity of 100,000 gallons each, $11,990.

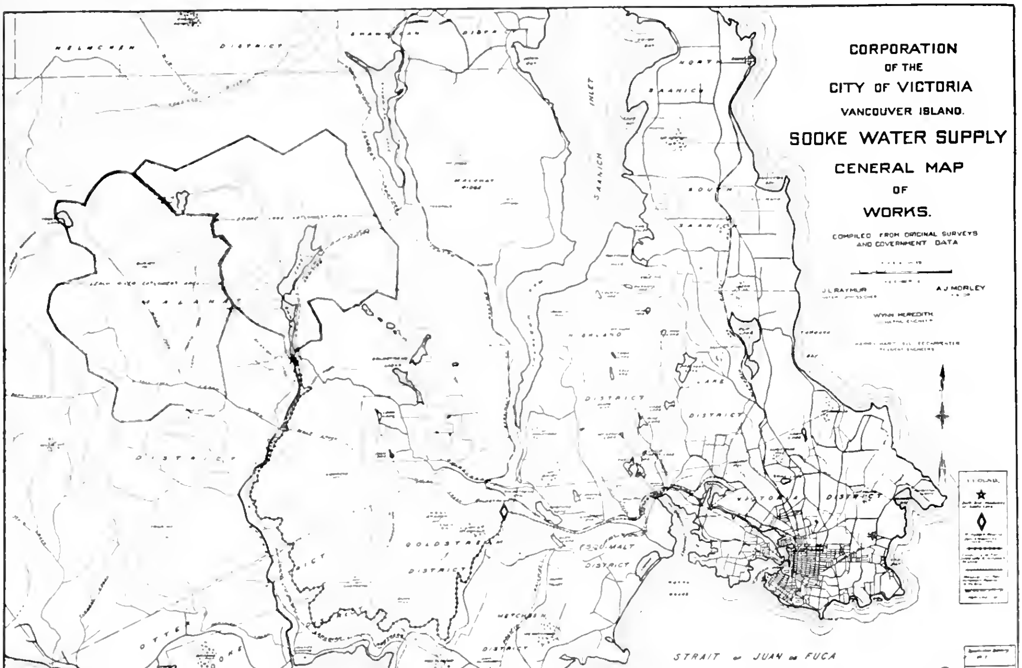
JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JANUARY 27, 1912 | NUMBER 4

THE SOOKE WATER SUPPLY SYSTEM

The water supply system for the city of Victoria, British Columbia, for which the contracts are now being drawn, has many interesting details. The general scheme that the work contemplates is the utilization of the waters of Sooke Lake, which lies in the will be raised 12 feet by means of a concrete and earth-filled dam at the southern end of the lake, affording by this means a storage of over 13,000 acre feet. The catchment area tributary to this source is about 31 square miles, and the average annual rainfall 70 inches.



Map of Sooke Water Supply System, about to be constructed, showing the positions of the Sooke Lake Catchment Area, the Lake with dam and headworks at southern extremity, conduit line to Humpback Reservoir and pressure line to Victoria. Sooke Basin and the Canadian Northern Pacific Railway, now under construction, will offer shipping facilities.

Malahat District to the northwest of Victoria about 18 miles. The piping system will convey 16 million imperial gallons of water daily from Sooke Lake to the present mains of the city.

The present elevation of the lake is 655—Victoria datum—or 555 feet above sea-level. The lake level From the lake to the pressure reservoir, near Goldstream, there will be constructed a reinforced concrete pipe, 40 inches in diameter, laid on a grade approximately 1 foot in 1000. The pipe will be 24 miles in length and extremely crooked. It will be without pressure, and will empty into Humpback Reservoir at

elevation of 495. From this elevation the water will cascade into the reservoir, which will have its normal full level at elevation 480. This pressure reservoir will contain approximately 130 million imperial gallons, and to retain this quantity there will be constructed a concrete dam containing 8000 cubic yards, and 400 feet in length, with a maximum height of approximately 50 feet above bedrock. Passing through the headworks and a large Venturi meter, the water will enter a 36-inch riveted steel pipe to be conveyed to the city, where a connection will be made to the existing distributing system.

The specifications for the work were turned over to the City Council on November 1st of last year by Wynn Meredith of the engineering firm of Sanderson & Porter. No untried or experimental features are included, and designs of a highly ornamental, or expensive character, have been avoided, the utilitarian features receiving first consideration. The construction provided for is of a substantial character, as it should properly be for municipal works.

No provision has been made for covering the flow line conduit between Sooke Lake and the Humpback Reservoir as a protection against freezing. Such pro-

					Successful Bidder	Average Bidder		Partial Bidder		Engineers' Estimate	
		DESCRIPTION.	Quantity.	Unit Prices.	Lump sum.	Unit price.	Lump sum.	Unit price	Lump sum.	Unit price.	Lump sum.
A.	1.	Excavating drain channel, earth..	100 yds.	$1.50	$150	$1.10	$140	$0.83	$83	$1.60	$160
	2.	Excavating drain channel, rock..	350 yds.	7.50	2,625	4.20	1,466	3.30	1,155	3.00	1,050
	3.	Clearing	300 ac.	150.00	15,000	276.00	82,833	135.00	10,500	250.00	75,000
	4.	Clearing submerged	80 ac.	250.00	20,000	242.00	19,574	135.00	10,800	200.00	16,000
	5.	Wagon road	11,600 ft.	1.50	17,400	1.14	13,237	1.04	12,061	1.10	17,000
	6.	Haleys bridge			500		510		600		1,200
		Total Schedule "A"..........			55,675		117,760		35,202		110,410
B.	1.	Dam exc., earth..................	2,100 yds.	.70	1,680	1.08	2,600	.66	2,551	1.00	2,100
	2.	Dam exc., rock..................	1,300 yds.	1.75	6,175	3.91	5,110	3.00	3,900	2.00	2,600
	3.	Concrete in foundations.........	520 yds.	11.00	5,720	11.10	5,954	9.00	1,680	15.00	7,800
	3.	Concrete in foundations.........	10 yds.	15.00	150	15.30	153	11.00	110	15.00	150
	3.	Concrete in foundations.........	10 yds	13.00	130	13.20	132	10.00	100	15.00	150
	4.	Dam and intake..................			30,000		30,065		19,400		28,259
		Total Schedule "B"..........			43,855		44,011		27,741		11,359
C.	1.	Exc. earth, pipe bed.............	26,500 yds.	.60	15,900	.79	20,905			.76	20,190
	2.	Exc. rock	69,000 yds.	1.75	120,750	2.43	167,823			1.90	131,100
	3.	Clearing right of way...........	23 mls.	2,100.00	55,200	1,900.00	43,761			1,195	31,375
		Clearing right of way...........								652	15,000
	4.	Trestles, 5-ft. bents............		Per bent, 52.00	2,080		3,125				
	4.	Trestles, 10-ft. bents............		Per bent, 60.00	3,000		4,745				
	4.	Trestles, 15-ft. bents............		Per bent, 80.00	1,120		1,656				55,319
	4.	Trestles, 20-ft. bents............		Per bent, 100.00	1,200		1,582				
	4.	Trestles, 25-ft. bents............		Per bent, 140.00	1,120		1,169				75,000
	4.	Trestles, 30-ft. bents............		Per bent, 180.00	720		882				
	4.	Trestles, 35-ft. bents............		Per bent, 215.00	430		481				
	5.	Culverts, 12-inch		Per foot, 1.10	1,540		2,478				
	5.	Culverts, 24-inch		Per foot, 3.20	2,880		3,550				8,000
	5.	Culverts, 40-inch		Per foot, 6.00	3,000		3,472				
	6.	Ravine crossing	150	Each, 97.00	14,550		16,683			Included in trestles.	
	7.	Wood stave pipe................	118,000 ft.	2.17	241,460		573,726			3.67	133,365
	8.	Steel riveted pipe...............	120,000 ft.	5.25	660,000					9.61	1,152,940
	9.	Concrete pipe	125,000 ft.	2.53	316,250		566,914			4.15	516,710
	10.	General			7,000		10,534				9,280
		Totals Schedule "C" with wood stave pipe.........			471,950		857,085				706,629
		Totals Schedule "C" with steel riveted pipe.......			890,490						1,426,204
		Totals Schedule "C" with concrete pipe			546,740		850,303				809,655
D.	1.	Earth exc.	5,300 yds.	.65	3,445		5,112	.85	1,505	1.50	7,950
	2.	Rock exc.	750 yds.	4.00	3,000		2,391	2.20	1,650	3.00	2,250
	3.	Clearing reservoir	40 ac.	350.00	14,000		19,445	75.00	3,000	300.00	12,000
	4.	Gravel bottom	10,000 yds.	1.00	10,000		17,845	2.00	20,000	1.00	10,000
	5.	Concrete foundations	200 yds.	12.50	2,500		2,616	11.00	2,200	15.00	3,000
	5.	Concrete, Class "B"............	10 yds.	10.00	100		110	9.00	90	10.50	105
	5.	Concrete, Class "C"............	500 yds.	9.25	4,625		1,578	7.50	3,750	8.00	4,000
	6.	General			33,000		90,881		15,000		107,276
		Total Schedule "D"..........			70,670		143,278		50,195		146,581
E.	1.	Earth trench	54,000 yds.	.60	32,400		42,066	.75	40,500	.70	37,800
	2.	Rock trench	10,000 yds.	3.00	30,000		31,810	3.00	30,000	3.50	35,000
	3.	Trench backfill	50,000 yds.	.15	7,500		16,250	.50	25,000	.50	25,000
	4.	Concrete piers, Class "B"........	600 yds.	20.00	12,000		9,072	12.50	7,500	20.00	12,000
	4.	Concrete piers, Class "A"........	10 yds.	20.00	200		173	15.00	150	20.00	200
	4.	Concrete piers, Class "C"........	10 yds.	18.00	180		115	10.00	100	15.00	150
	5.	Lap welded pipe.................	54,000 ft.	7.00	378,000		177,600	8.25	445,500	7.15	385,904
	6a.	Steel riveted, 5/16-inch.........	19,000 ft.	5.25	99,750		156,777	8.85	168,150		
	6b.	Steel riveted pipe, 3/8-inch......	35,000 ft.	6.25	218,750		327,700	9.90	346,500		
	7.	Lock bar pipe....................	54,000 ft.	6.80	367,200		448,500	8.10	437,400		
	8.	General			22,000		32,408		60,000		27,490
		Totals Schedule "E" with lap welded pipe.........			482,280		609,494		608,750		523,541
		Totals Schedule "E" with steel riveted pipe........			422,780		616,371		677,900		
		Totals Schedule "E" with lock bar pipe...........			471,480		580,351		600,650		
				Sum of Schedules	Tender F.		Sum of Averages.				
F.		Wood stave and lap welded......		$1,154,430	1,154,430		1,771,431				1,528,541
		Wood stave and riveted....		1,094,930	1,094,930						
		Wood stave and lock bar....		1,143,630	1,143,630		1,778,308				
		Concrete and lap welded pipe		1,229,220	1,229,220		1,764,619				1,631,519
		Concrete and riveted pipe....		1,169,720	1,169,720		1,771,526				
		Concrete and lock bar........		1,218,420	1,218,420		1,735,519				

December 29, 1911.

tection is, it is believed, unnecessary, and on account of the scarcity of material available, would prove somewhat expensive, but should it be found needful at a later date, the cost would be no greater than at present. Experience with the open flume of the Jordon River development of the British Columbia Electric Railway Company, during last winter, confirms this opinion. This flume is located at a higher elevation, and subjected to more severe conditions, than will prevail on the flow line conduit, and little or no difficulty was experienced in maintaining a continuous flow of water throughout the winter. Necessarily, standpipes, air valves, relief valves and fittings will be enclosed in wooden boxes and packed with sawdust for frost protection.

The subdivision of the contract into different schedules was made with a view of obtaining separate tenders upon various parts of the work. The division into schedules is a natural one, by virtue of location and the different classes of construction and materials required, and has resulted in obtaining tenders from responsible contractors experienced in the respective classes. Schedule F combines and includes in one tender all of the work and items in Schedules A, B, C, D and E.

Bids were opened for the contract on December 15th and the firms below submitted tenders. No tender was received and deposited by the city unaccompanied by a certified check for $15,000. With the awarding of the contract all checks were returned to the respective tenderers except that of the successful firm. The check of the latter was returned with the signing of the contract and filing of the required bond, which was 10 per cent of the contract price to guarantee a satisfactory completion of the work. A forfeiture of the check of course would have obtained in case the bidder failed to enter into the agreement.

The quantities in the schedule are approximate only and were given as a basis for uniform comparison of bids. The quantity of any class or portion of the work may be increased or decreased as may be deemed necessary by the engineer. An increase or decrease in the amount of excavating or in the amount of masonry or concrete will not alter the unit prices nor the time allowed for completion of the work.

The rate of progress prescribed is shown thus:

Three months	6%	of work	completed.
Six months	15%	"	"
Nine months	45%	"	"
Twelve months	55%	"	"
Fifteen months	65%	"	"
Eighteen months	80%	"	"
Twenty-one months	95%	"	"
Twenty-four months	100%	"	"

The contractors who tendered bids are: The Westholme Lumber Co., Victoria; The Graff Construction Co., Seattle; Naylor Bros., Vancouver; Norton, Griffiths & Co., Ltd., Vancouver; Holf & Jeffrey, Seattle; Victoria Machinery Dep., Porter Bros., Victoria; Geo. C. Deitrich & Co., Seattle; Sound Construction Co., Seattle, and P. J. McHugh, Seattle.

The contract, including concrete flow line pipe and riveted steel pressure pipe, was awarded to the Westholme Lumber Company at the price of $1,160,720. This sum is shown segregated among the various items in the accompanying table, which also shows the Average of Tenders, the Engineer's Preliminary Estimate and the Completion Requirements.

The by-law authorizing this contract was approved by the taxpayers at the General Municipal Election held January 11, and there is every reason to expect the work to proceed at once.

Sooke Harbour offers many facilities for delivery by water of materials and supplies adjacent to part of the work, and the Canadian Northern Pacific Railway will offer similar service. This railroad is now in process of construction from Victoria north along Sooke River, approximately paralleling the flow line conduit from Sooke Harbour to the lake. The grading of this line is now completed to within about 1½ miles of Sooke Lake and it is probable that the track will be laid early this year.

THE PROPOSED MAMMOTH WIRELESS TOWER.

The Memorial Tower, the construction of which has been endorsed and approved by the Board of Directors of the Panama-Pacific International Exposition, has become of world-wide interest, on account of the wireless possibilities. If the shaft is placed in Lincoln Park and a wireless station installed in the tower, it will make San Francisco the highest-powered station in operation and will produce long distance results hitherto considered impossible, placing San Francisco in direct communication with Washington, Key West, Colon, Honolulu, all Alaskan stations, vessels in the Pacific, and possibly with stations on the coast of Japan.

A letter received from George von L. Meyer, Secretary of the Navy, says:

"The Navy Department is taking steps towards erecting a high-power station on the California coast, in connection with its chain of wireless stations across the Pacific, and for communication with ships in the eastern Pacific Ocean. Since the range of wireless depends principally upon the height of the aerial wires above the ground, and since the location of this station at San Francisco would be most advantageous to that city, it would seem that the Memorial Tower should be erected with a view to its use for supporting one end of an aerial of the most powerful wireless station in the world. The Eiffel Tower in Paris, 1000 feet high, has produced wonderful results in long distance wireless work, and the proposed tower, 1350 feet above sea level, would insure even more remarkable results.

"A site near the ocean beach at San Francisco will give ideal wireless conditions, there being no tall buildings or trees in the sending direction, and I strongly recommend that, before the exact site of the Memorial Tower is selected, the Navy Department be consulted as to the needs of the proposed wireless station. Such a station would in no way interfere with the use of the tower as an observation station for visitors, or for its use as a weather station. The small wires of the aerial could not detract in the slightest from the appearance of the tower, while adding greatly not only to its utility, but to its attractiveness for visitors."

EVOLUTION VS. REVOLUTION IN PUBLIC SERVICE.[1]

BY T. B. COMSTOCK.

As in most of the so-called revolutions of history, the reform substituted for the earlier regime is but a grafting of new ideas upon old stock.

There was plausibility which went far to excuse the visible methods of the trusts in destroying competition, and there might have been a longer and a brighter epoch of consolidation had only the brainy chiefs of the new system been able and willing to demonstrate practically the real merit of their scheme by an equitable distribution of the gains, through lowering of prices, or even by measuring capitalization on the basis of actual investment. But there is another point of view which the mass of the people are not prone to regard. The power acquired to set the price of the necessities of life through the ownership of public utilities and the control of production and distribution did not come by chance, nor by simple annihilation of competition. It was as much due to risks taken by the lambs of the people in speculating in over-valued securities and to their failure to get orthographic projections of the perspective presented. Now that the public spirit is awakening, there is grave danger that it will be led astray as far in the opposite direction by the counsels of such as know no antidotes for poison save drastic emetics.

If the people had not been implicated in the deal by their participancy in the transactions in Wall Street their case would have become more a matter of legitimate business and much less a football for office-seeking politicians than it appears today.

Gradually, but slowly, we are approaching better conditions, thanks to the calm and patient work and self-sacrifice of those who care only for the reward that comes from consciousness of well-doing. And I can say to you, fellow engineers, that the hope for the future which no untoward event can drive from me, is dependent upon the firm conviction due to abundant experience, that the courts and the lawyers, on both sides of these public questions, have already gone about as far as is possible along the lines of action demanded by the theory of their profession.

I have so often compared notes with other engineers, and have had so much benefit from their well earned opinions, that I feel warranted in asserting that the solution of the economic problems of the coming days must eventually be recognized as fittingly and peculiarly adapted to the engineer's field of labor.

There are two elements of danger to the life of any profession. One is the pride of cult which may come from the culmination of authority. The other is the ultra-conservatism which is liable to result from the clannish spirit developed.

The profession of engineering is now established by the justification of itself by its works in many branches of construction and operation. There are partisans and charlatans, too, in our own ranks, who do not scruple to veer with the breeze which blows most money or other sordid gain to their hand. They are products of the same unprofessional systems which, by association with degraded trade methods, have honeycombed the better recognized professions with corrupt practices.

These dangers have been largely forestalled by better methods of applying engineering testimony in the deliberations of boards directly concerned in the regulation of public service. New York, Wisconsin and other States have set the mark in this particular, and nearly all the civic powers engaged in this duty have permanent staffs of engineers employed.

Reports of these various commissioners show clearly that at least from 2/3 to 4/5 of the scope of work performed consists of matters which require reference to engineers in first instance. And the largest proportion of these are decided upon rulings formulated by the engineering staff.

It could not well be otherwise, when the engineering character of the service is duly considered. And it is gratifying to observe that the decisions of engineering questions and matters of accounting which have been adjudicated by the several boards, on the advice or by direct ruling of the engineering corps, have almost always been identical where equivalent principles have been involved.

The need of public regulation of public service is apparent to all who have given close attention to the abuses which have grown out of loose and venal methods of handling such business. And this need is recognized and freely admitted by the most capable of the managers and staffs of the operating companies themselves. Between the attitude of him who was reported as saying "The public be damned," and the agitator who would counsel destruction of the plant as a source of relief from corporate greed, there is a mean line of equal justice to which both the public and the corporations should be brought as speedily as possible. There never will be complete and satisfactory public service until this be accomplished in a spirit of friendly co-operation. And it is a matter of very great moment at this juncture to have this done intelligently and permanently, so that its practical success may be demonstrated and its continuance guaranteed.

The conditions existing in Los Angeles are peculiar and not well adapted to the immediate application, in toto, of a plan based upon an ideal situation. It would be much simpler and more facile in regulation to have each utility monopolized by one corporation, instead of two or three companies of each kind serving the same territory.

But we have to consider that the competition, which is really incompatible with the theory of regulated monopoly, the very plan adopted for overcoming the evils of competition—was fostered and extended by the people for the purpose of obtaining just what the new plan is now supposed to ensure.

The best way is to let "Nature take her course," and this has already resulted in such rearrangement of the transportation service as to accomplish, at least on paper, the realization of the ideal. That is to say, the local lines may now all be regarded as one monopoly unit, ostensibly, and all the interurban lines as another unit monopoly.

So, from construction and operating standpoints,

[1]Abstract from paper presented Dec. 19th, 1911, before the A. I. E. E. and Engineers' & Architects' Association, Joint Meeting, at Los Angeles, Cal.

regulation is becoming more practicable than would have been possible formerly. But the gridiron has grown with the expansion of the city without much reference to any general plan for the future. With a much greater number of cars per mile of track than other cities, the distribution of traffic is such as to cause serious congestion in rush hours, in many parts of the business district. Attempts to overcome this piecemeal have been about as futile as to try to tickle a mule in the flanks without making him kick, or to catch an agile fly.

The only way out of the puzzle is to earnestly and persistently watch the traffic and study its statistics, making direct crossings of streets as far as possible to eliminate curves and routing cars over looped circuits to avoid obstruction of streets by trolley turnings.

The problems which confront officials charged with the duty of regulating public service in the hands of private corporations, are not very different from those which constantly beset these operatives themselves. Sometimes the registering of a complaint with a city board may expose a blemish or a deficiency of service which had not been previously noticed or regarded as important by the railway officials. Occasionally honest difference of opinion may result from investigation from both sides, and there may be necessity for ruling against the contention of the company's representatives. Again, it may happen that a tentative judgment of the regulating body will be found inapplicable after consideration of more evidence produced by the company.

There may be short periods of excited public feeling when all considerations of justice appear to be thrown to the winds. It is quite as much to the people's interest in the long run that they be protected from untoward results of their own ignorance or imprudence as to be guarded from purely selfish aggression on the part of the utility corporations.

No member of the board or any of its officials should be chosen or retained in position unless he be fully capable of sifting evidence, of character unimpeachable, without any interests or political aspirations which may prejudice him for or against one side or the other in advance of specific investigation. He must of necessity refrain from investment and from advising others on investments in public utilities or securities in any way related to the business amenable to his jurisdiction. He ought to be one of ripe years of experience in construction, operation and executive work, with practical knowledge of the principles involved and of the sources of supply, the forces utilized and the requirements of the service which he undertakes to supervise.

The average politician, and sometimes the appointing power itself, is incompetent to select even if there be intent to select, just the proper persons to sit in judgment upon questions which require intimate acquaintance with details and adequate knowledge of the relations of parts in operation.

Unless politics, in the sense of wire-pulling, intrigue and partisanship, can be absolutely divorced from the regulating board, it will be futile to hope for results that will satisfy.

The pecuniary stipend of such men as are qualified will have to be placed far above the ordinary allowance, or the incumbents must be sought among those who, with equivalent earning capacity, are so situated that they may afford to serve regardless of the remuneration offered.

There are three methods of supervision in effect in the United States outside the scope of the Inter-State Commerce Commission, which is not included in this discussion.

New York State, Massachusetts, Wisconsin, Washington State, California (just beginning) and other States and cities have boards of from 3 to 23 members, who are given varying degrees of jurisdiction over more or less restricted range of service.

Some cities, like Los Angeles, Chicago, St. Louis, Kansas City, Boston, Baltimore and others, have boards, usually of three members, whose jurisdiction and degree of control and initiative are not strictly comparable. There is no uniformity of powers or methods in this class.

In many cities, as Des Moines, Seattle, St. Louis, etc., the so-called commission form of government has been adopted in many varieties of expression. So far as the public service regulation is concerned, in the majority of these last instances, one man is the responsible executive head of a bureau, charged with powers and duties of autocratic nature, and subordinate to the council of similar chiefs, of which he is a member.

All of these commissions are ostensibly intended to meet the popular demand for one and the same principle in government. They are, however, about as widely divergent as if born of unrelated conceptions. This result is due more to differences in State Constitutions and local city charters than to intentional variations in practice. Some are wholly experimental, their continuance probably as much dependent upon the personnel of the incumbent officials as upon the method of action prescribed.

One great obstacle in the way of speedy and correct solution of our public service problems is the lask of understanding of perspective, the inability of many people, including ordinary citizens, and some public officials and coporation managers, to measure things as they are, instead of as they may appear at different distances and from a single point of view. The training of the architect and the engineer and his habit of work lead him to prepare perspective drawings for his public; but his files of working plans are drawn in orthographic projection, his constructive and operative work are based upon combinations of many perspective views.

Transportation is the most complex and most important, and at the same time the real fundamental issue in the regulation of public utilities. It demands most capital, most concessions and privileges from the community and it is most essential to the inhabitants in their daily movements for all purposes. The location and development of industries, the filling up of residence districts with homes, the character and extent of a city's growth, the distribution of parks, school houses, churches, theatres and various other accessories are wholly dependent upon the layout of the traffic arteries, and no acceptable or effective city plan can be laid out independently of these.

If all railways of every kind within the city limits were to be operated by electricity, as is, perhaps imminent, the casual observer might regard them as of one class. Until recently, it was customary with some degree of propriety to segregate them in two groups as steam and electric. But now it is daily becoming more necessary to make three main divisions, and probably some six subdivisions will be recognized as essentially distinct in regulation before very long. This complete list comprises:

Divisions.	Sub-Divisions.
1. Trunk Line	A. Passenger
	B. Freight
2. Inter-Urban	C. Rapid Transit
	D. Accomodation
	E. Express-Freight
3. Inter-Mural	F. Local Passenger

Within the past year significant changes of technical ownership and management have occurred which have left the situation ostensibly as here presented. But I am not sure that this classification in detail is in strict accord with the designs of those in control of the destinies of all the operating lines, nor can I predict with surety what changes may be wrought by legislation under influence of those who may be in authority in the city government for the next five years.

The grouping here given, is based upon close study of the history of the development of the transportation systems for nearly fifteen years and upon two years of daily experience with the necessities and short-comings of the unwieldy status quo.

The status of the interurban service is far from satisfactory from the standpoint of the city or of the company. It is a nice problem in engineering economics, and there are others connected with local service which cannot be solved by juggling with them, nor will they be settled without patient forbearance and co-operation on the part of the public and the corporations interested

There are two methods of approaching and handling the railway situation in Los Angeles, now, that we have fairly well ascertained what is the matter with the mix-up. City officials and the corporations may work together in harmony, but independently in acquiring adequate knowledge of facts and in comparing notes and striving to adjust differences amicably, even at some sacrifices of acquired or inherent rights. Or each party may stand upon the letter of the law and quibble and quarrel until one or other (or possibly both) be beaten in the contest. Which is the better way in the estimation of those to whom the work is entrusted on either side may be dependent largely upon the training and experience of the arbitrators. My observation shows that the training of the engineer best fits him to meet the issues, because, if he be worthy his profession, his first and greatest ambition must be to get at the facts, and then to adjust matters for the economical working of the machinery and the prevention of waste.

There are corporations and corporations. All cannot be treated alike. Some deserve respect, others need coercive treatment. Only one who knows the difference between the two classes is capable of attacking his problem intelligently. Mutual respect between officials of the city and the corporation is an excellent working asset for both. But this cannot be maintained unless both are sincere.

A gentleman with moderate business experience in retail merchandising was asked to assume the position of general manager of one of the largest mining companies in Colorado. He modestly delined on the ground that he knew nothing of the business. The reply was "All you need is to get a good foreman, and you can handle it as well as anybody." Too many corporations thus do manage with ANY body as the nominal head.

Another very important enterprise was in control of a man who had no practical knowledge of the business and was without training. At his death, his most efficient skilled lieutenant succeeded him. In one year the reduction of costs, increase of output, stoppages of waste and improvements made, completely revolutionized affairs. The new manager had become pecuniarily worth hundreds of thousands of dollars to the corporation.

In another case, a trained and careful manager resigned, because he was offered an increase of salary by another corporation. He was succeeded by an accounting officer who judged results by the books alone. He had a hobby, and proceeded to demonstrate that greater saving of metal was possible than had ever been shown by his predecessor. The result in net earnings the first year was a decided gain, and his slags were cleaner. Proud of his supposed achievement, he gave way to a man familiar with the "kraft and stoff" of the art, who shortly found that the furnace linings required renewal, (the lack of reworkable slag for mixtures demanding higher heat) and that the reserve supply of fuel purchased in prior years, was almost exhausted, while the plant in general had been greatly damaged. At the same time, no outlay for opening new ground had been incurred and repairs had not been kept up. The books and the pockets of stockholders showed increased net earnings; but the net results were on the other side of actual profit and loss.

One railroad company was officered by capable men, constructing and operating engineers, in effect, but these were dominated by the legal staff and manipulators of securities, who were engaged in the process of wrecking the plant for ulterior purposes. You probably know how that turned out as a business organization.

There is a gigantic system of operations conducted by a public utility corporation, whose attorneys are noted for keeping out of litigation and amicably adjusting difficult situations. But the active management and control rest with an untrammeled engineering staff, whose record is superb for low cost and high quality of output under stringent regulations as to rates and conditions of operation.

Now I think you must have already made due application of the significance of these facts in their bearing upon the right regulation of public service. And please bear in mind that the public and its officers can go as widely wrong in their conclusions as to adequate rates and reasonable privileges and restrict-

ions as the owners and operators of the plants which furnish the necessities of life. Public ownership, if it be successful, pre-supposes efficient management, and this cannot be secured by election or appointment of responsible officials without knowledge of the work they are permitted to supervise.

There are two dangers lurking in the appointment of utility boards, and the fixing of rates and regulation of service by elected officers, even when their honesty of purpose is assured. One arises from uncertainty of the ability of these officers to determine correct standards of cost and efficiency. The other comes from lack of such experience as will enable them to apply standards justly in individual instances.

The time must come when it will be generally recognized that unbiased determination of facts as they are, and ruling thereon without prejudice or partisanship, is the only method of securing efficient service at justifiable rates.

Municipal ownership is neither the "bug-a-boo" nor the "cure-all" claimed for it by its enemies and friends respectively. It will not replace successfully the private corporation unless it retains the principles of good management and discards the elements of bad management which attach to the present system of distribution. It will surely replace the private corporation, as a matter of public necessity, unless there be found effective means of securing the same ends by public control.

Any man or woman who cares more to justify opinions than to reconcile opinions to the truth is a menace to society, whether the cause be venal motive or ignorance. Incorporation of utilities under public ownership is but an evolution of the private corporation, itself the evolution of individual proprietorship.

Finally, it is the engineer who will be in demand in the future, because his profession is the one which trains an unbiased attitude and the getting of results in accordance with the immutable laws of Nature, which after all determine the price of water, gas, electric current, telephone service and transportation of goods and of men.

But all these irritating questions, which afford free capital for loud-mouthed agitators, are to be settled by force of circumstances beyond any man's power to permanently brook, and the most of them are merely side issues to the main necessity of directing public control into wholesome, intelligent and competent channels of administration.

Engineers must think upon these matters, and to a purpose; and in much larger degree than some of you may be aware, the settlement is to come from the work of engineers who can see clearly, act promptly and meet and conquer in emergencies. The real engineer is the one who conquers emergency situations, and an emergency is confronting us now which demands courageous and dauntless energy to prevent dire disaster. As the true engineer will save life at any cost of property, in case of fire or flood, so must every consideration now be made to give way in our ranks, to the greater good of humanity. But coolness and calm judgment are as necessary as bravery, and there is no call for sacrifice of the substance in order to save the unknown shadow which may not prove to indicate the presence of a human, after all.

SIX METHODS OF COMPUTING IRREGULAR AREAS.[1]

BY ROBERT SIBLEY.

The engineer is often confronted with the problem of computing the areas of irregular figures. Of course, when a figure has definite symmetrical boundaries the computation of areas by the simple laws of elementary arithmetic and geometry follows at once. When, however, the boundary line of these areas is irregular in shape, at times it becomes a problem to estimate the enclosed area with a sufficient degree of accuracy, especially if no planimeter or mechanical area measuring machine is at hand. It is convenient, then, to have at hand definite methods with which to attack the problem of area computation when caught short-handed.

The following methods are compiled particularly for the computation of areas for indicator cards but as a matter of fact they are equally applicable to all other areas necessary to be computed. The six methods to be discussed in this lecture are as follows:

1. The small square method.
2. The trapezoidal rule.
3. The line proportional to area method.
4. By weighing.
5. Simpson's rule.
6. The planimeter.

Let us now proceed to study these six different methods and master them if possible, in order that we may be ready at all times to meet such problems as may arise in the computation of areas. By mastering these six methods we can pick from them when occasion arises the one which will apply with the greatest degree of accuracy upon the problem in which it is necessary for us to compute the area.

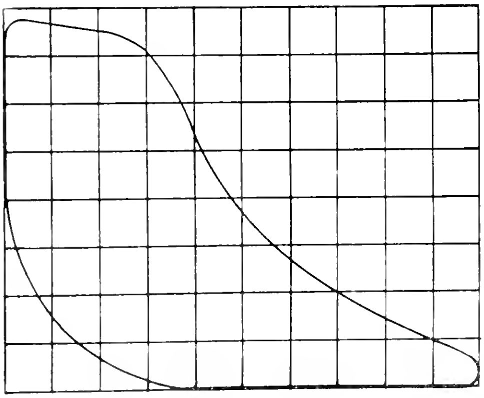


Fig. 1. The Small Square Method

1. The small square method. By reference to Fig. 1 we see that the irregular shaped area is first platted to a definite scale and then the entire enclosure is divided into small squares. By simply counting these squares and approximating the small fractions of squares around the perimeter of the area and adding these to our number of whole squares, we

[1] This paper comprises the Eighteenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

thus arrive at a value for the complete area enclosed. If now we multiply this area by the square of the scale to which our figure is drawn, we at once arrive at the area. It is evident that the smaller these squares are made the more nearly will we arrive at a true result. Hence squares should be taken as small as is convenient in the working out of a definite problem.

2. The trapezoidal rule. This method is used a great deal in the computation of railway road-beds and other earth excavation work. The given figure, which is seen by referring to Fig. 2, is divided by a series of equally distant parallel lines; such as a, b, c, d, etc. As shown in Fig. 2 the individual line is distant from its neighbor by h units. By looking at this figure we see that the small areas now making up the complete enclosure are very approximately trapezoids.

In elementary geometry we learn that the area of a trapezoid is equal to ½ the sum of the parallel sides multiplied by the perpendicular distance between them. Hence looking at Fig. 2 we see that the area of the first small enclosure on the left is $\left(\frac{a+b}{2}\right)h$, and the area of the second small enclosure $\left(\frac{b+c}{2}\right)h$, and likewise the area of the third

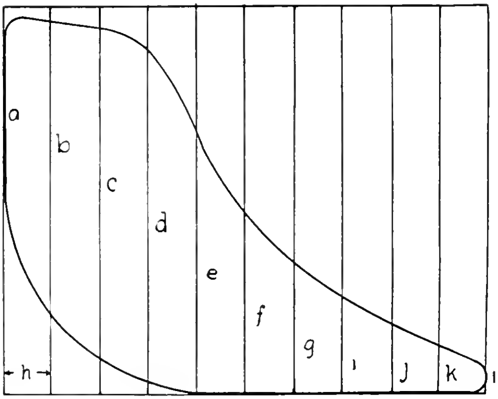


Fig. 2. The Trapezoidal Rule.

small inclosure is $\left(\frac{c+d}{2}\right)h$, and so on. The total area of the enclosed figure is, therefore, equal to the sum of these individual areas which is expressed algebraically

$$\text{Area} = \left(\frac{a+b}{2}\right)h + \left(\frac{b+c}{2}\right)h + \left(\frac{c+d}{2}\right)h + \ldots + \left(\frac{k+l}{2}\right)h$$

$$= h\left(\frac{a}{2} + b + c + d \ \ldots\ldots + k + \frac{l}{2}\right)$$

In other words the area by the trapezoidal method is equal to the summation of one-half the first ordinate plus the sum of the intermediate ordinates plus one-half the last ordinate multiplied by the distance between any two. This is seen, then, to represent a remarkably easy yet accurate method of arriving at the area of an enclosure.

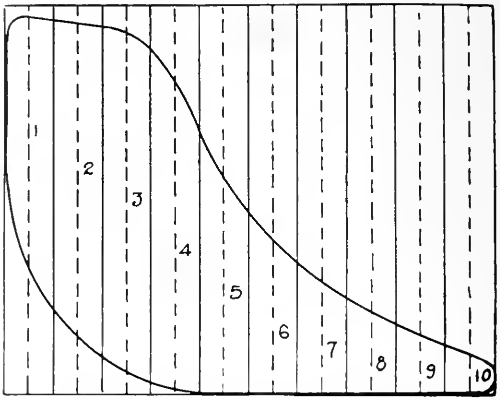


Fig. 3. The Line Proportional to Area Method.

3. The line proportional to area method. As signified by the name this method consists again in dividing the figure in small areas as shown in Fig. 3. By reference to this figure it is seen that by their average length 1, 2, 3, 4, etc., represent approximately by their length the area of each little small subdivision, hence if we scale off these lengths and sum them up either graphically or arithmetically we can at once arrive at an approximate measurement of the whole of the enclosure. This process while not as accurate as the trapezoidal method, is yet more convenient at times, especially in the case of certain graphic treatment of forces met with in the design of roof and bridge structures. In its use, however, by simply dividing the area of any figure, it is simple and easy of application.

4. By weighing. When one has ready access to a set of balances, this method is at once simple and accurate. It consists simply of plotting accurately to scale the enclosure which contains the area desired. It is necessary, however, in choosing and selecting the paper upon which this enclosure is platted to

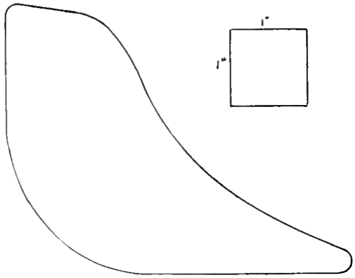


Fig. 4 Method of Weighing.

use careful judgment in the way of choosing an even, uniform paper.

After the enclosure has been carefully and accurately plotted to the scale, the outline of the figure as

shown by illustration in Fig. 4 is cut out with a pair of scissors and weighed upon a pair of delicate balances. After this has been performed an area, 1 in. x 1 in. or in other words an areea of 1 sq. in. is also weighed upon the scales. It is seen now that the true area of the figure described is as many square inches in size as the weight of the one sq. in. section is contained in the weight of the complete area.

5. Simpson's Rule. In the consideration of the trapezoidal rule we find that the end lines connecting the non-parallel sides of the small areas were assumed to be straight, whereas in reality they are curved.

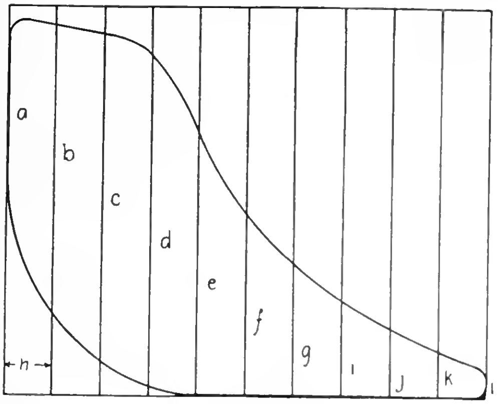


Fig. 5. Simpson's Rule.

Years ago, a mathematician and engineer by the name of Simpson, observed this fact and still further approximated the area of each small enclosure. This approximation is in fact so exact that it has been adopted universally by engineers in the computation of areas. In deducting the theoretic basis for his rule, Simpson made use of the well known theorem in analytic geometry that "the area of a segment of a parabola is equal to two-thirds the area of the circumscribing parallelogram." Looking now for an instant at Fig. 6, we can at once follow the simple reasoning by which this useful law was founded. In this figure BDGF, represents the segment of a parabola, the area BCDEGF represents the area of the circumscribing parallelogram in which the point D in the line CE is tangent to the parabola.

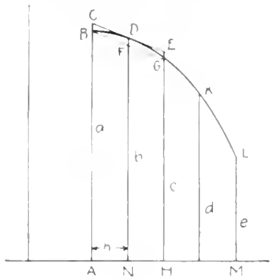


Fig. 6. Analytical Proof of Simpson's Rule.

If now we divide the parabolic arc BDGKL into an even number of small areas shown at a, b, c, d, e, some interesting results follow. Let us for a moment consider the area of the figure ABDGH.

$$\text{Area ABGH} = \left(\frac{a+c}{2}\right) 2h$$

$$\text{Area BDGF} = 2/3 \text{ Area BCDEG}$$
$$= 2/3\,(DF) \times 2h$$

$$\text{But } DF = DN - FN$$

$$\text{or } DF = b - \frac{a+c}{2}$$

$$\therefore \text{Area BDGF} = \frac{2}{3}\left(b - \frac{a+c}{2}\right) 2h$$

$$\text{Hence areas ABDGH} = \left(\frac{a+c}{2}\right) 2h + \frac{2}{3}\left(b - \frac{a+c}{2}\right) 2h.$$

In a similar manner the next two small areas can be grouped together and we have

$$\text{Area HGKLM} = \left(\frac{c+e}{2}\right) 2h + \frac{2}{3}\left(d - \frac{c+e}{2}\right) 2h$$

By adding this result to the former we get the total area shown in Fig. 6. Thus,

$$\text{Total area} = \left(\frac{a+c}{2}\right) 2h + \frac{2}{3}\left(b - \frac{a+c}{2}\right)$$
$$2h + \left(\frac{c+e}{2}\right) 2h + \frac{2}{3}\left(d - \frac{c+e}{2}\right) 2h$$

$$= h\left[a + c + \frac{4}{3}b - \frac{2}{3}a - \frac{2}{3}c + c + e + \frac{4}{3}d - \frac{2}{3}c - \frac{2}{3}e\right]$$

$$= h\left[\frac{a}{3} + \frac{4}{3}(b+d) + \frac{2}{3}c + \frac{e}{3}\right]$$

$$= \frac{h}{3}\left[(a+e) + 4(b+d) + 2c\right]$$

If now we let $(a + e) = A$, $(b + d) = B$, $c = C$, we have

$$\text{Total area} = \frac{h}{3}\left[A + 4B + 2C\right]$$

From this reasoning which is easily extended so as to cover any even number of small segments, it is seen that if any area is divided by means of a series of parallel equi-distant lines, forming an even number of small areas as were drawn in the consideration of the trapezoidal rule (although in that case the number of areas may be either even or odd), a complete law for area computation follows at once by means of the following rule. If A represents the sum of the first and last ordinates, C the sum of the other odd ordinates, B the sum of the even ordinates and h the perpendicular distance between each adjacent ordinate, then the

$$\text{Area} = \frac{h}{3}(A + 4B + 2C)$$

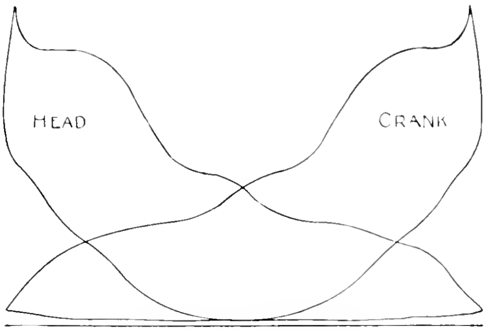
6. The planimeter. This method is at once the most exact and most popular method known to the modern science of engineering in the computation of irregular shaped areas. The planimeter appears to the trade in a variety of forms. The basis of the theoretic considerations upon which it operates involves the use

of that branch of higher mathematics known as calculus and hence the theory underlying it will not be undertaken at this time. Suffice it to say, however, that its principle depends upon sound reasoning.

In order to measure an area by means of a planimeter it is simply necessary to run a marker accurately around the perimeter of the enclosure whose area it is desired to obtain. It is of course necessary to observe certain other rules, depending upon the particular style of planimeter made use of by the engineer. As this instrument is however expensive and better adapted for office use than for the field, it is restricted in its wide-spread application largely to the draughting room. Hence a thorough mastery of the first five methods of computing areas as detailed in this lecture is very essential for the field engineer.

Thermotwisters.

1. Given the indicator cards of crank and head ends as shown below taken from a steam engine, compute the area by all six methods, thus satisfying yourself as to accuracy of each.



Problem in Area Measurement.

SOLUTION OF THERMOTWISTERS—TWELFTH LECTURE

1. If 500 B.t.u. are added to 6 lb. of air having a pressure of 30 lb. per sq. in. and a volume of 30 cu. ft. what is the final v, p, t and the work done?

(a) When the heat is supplied and expansion takes place at constant pressure.

(b) When the heat is supplied and expansion takes place at constant temperature.

(c) When the heat is supplied and the volume remains constant.

(d) When the heat is supplied and the expansion follows the law $p v^{0.6} = K$.

(a) $p_1 = 30 \times 144$ $v_1 = \frac{35}{6}$ $p_1 v_1 = R T_1$ $Q = \frac{500}{6}$ or heat supplied per lb.

$$T_1 = \frac{p_1 v_1}{R} = \frac{30 \times 144 \times 35}{53.37 \times 6} = 472.0$$

$$Q = C_p (T_2 - T_1) \text{ where } Q = \frac{500}{6},\ C_p = .239 \quad T_1 = 472.0$$

$$\frac{500}{6} = .239\ (T_2 - 472.5) \text{ or } T_2 = \frac{500}{6 \times .239} + 472.0 = 821.0$$

$$p v = R T, \quad v_2 = \frac{R T_2}{p_2} = \frac{52.37 \times 821.0}{30 \times 144} = 10.13$$

$$\text{Work} = 6 \times \frac{R}{1 - n} (T_2 - T_1) = 6 \times \frac{53.37}{1 - 0} (821 - 472)$$

$$= 18{,}620 \times 6 = 111{,}720 \text{ ft. lb. Ans.}$$

(b) Since law of expansion is in this case $p v = K$.

$$Q = p_1 v_1 \log_e \frac{v_2}{v_1}$$

$$778 \times \frac{500}{6} = 30 \times 144 \times \frac{35}{6} [\log_e v_2 - \log_e \frac{35}{6}]$$

$$= 30 \times 144 \times \frac{35}{6} \times 2.306\ [\log_{10} v_2 - \log_{10} \frac{35}{6}]$$

$$\log_{10} v_2 = \frac{778 \times 500 \times 6}{6 \times 30 \times 144 \times 35 \times 2.306} + \log_{10} \frac{35}{6}$$

$$= 0.1116 + 0.7661 = 0.8777$$

$$\therefore v_2 = 7.55$$

$$p_2 v_2 = p_1 v_1$$

$$\therefore p_2 = \frac{p_1 v_1}{v_2} = \frac{30 \times 144 \times 35}{6 \times 7.55} = 3336. \quad \text{Ans.}$$

All heat supplied goes toward work. Hence total work is $500 \times 778 = 389{,}000$ ft. lb. Ans.

(c) $Q = C_v (T_2 - T_1)$

$$\frac{500}{6} = .17\ (T_2 - 472.)$$

$$\therefore T_2 = \frac{500}{6 \times .17} + 472 = 962.5$$

(d) In this case $n = 0.6$ in the general equations.

$$Q = C_v (T_2 - T_1) + \frac{R}{1 - n} (T_2 - T_1)$$

$$\frac{500}{6} = .17\ (T_2 - 472) + \frac{53.37}{1 - 0.6} (T_2 - 472) \times \frac{1}{778}$$

$$\frac{500}{6} = (T_2 - 472.5)\ [.17 + \frac{53.37}{0.4 \times 778}] = (T_2 - 472.5)\ (.3415)$$

$$T_2 = \frac{500}{6 \times .3415} + 472.5 = 716.5. \quad \text{Ans.}$$

$$p v^{0.6} = K \text{ or } R T_2 v_2^{0.6} = R T_1 v_1^{0.6}$$

Substituting

$$v_2^{0.6} = \frac{T_1}{T_2} v_1^{0.6}$$

$$\therefore v_2 = v_1 \left(\frac{T_1}{T_2}\right)^{\frac{1}{0.6}} = \frac{35}{6} \left(\frac{472.5}{716.5}\right)^{\frac{1}{0.6}} = \frac{35}{6} \times .50 = 2.92. \quad \text{Ans.}$$

$$p_2 v_2 = R T_2$$

$$\therefore p_2 = \frac{53.37 \times 716.5}{2.92} = 13{,}100. \quad \text{Ans.}$$

$$\text{Work} = \frac{6 R}{1 - n} (T_2 - T_1) = \frac{6 \times 53.37}{1 - 0.6} (716 - 472.5)$$

$$= \frac{6 \times 53.37 \times 243.5}{0.4} = 194{,}800 \text{ ft. lb. Ans.}$$

2. The above air expands adiabatically until the final volume is 70 cu. ft. what is the final p, t, and the work done?

$$p_2 v_2^{1.41} = p_1 v_1^{1.41}$$

$$p_2 = p_1 \left(\frac{v_1}{v_2}\right)^{1.41} = 30 \times 144 \left(\frac{35}{70}\right)^{1.41}$$

$$\therefore p_2 = 30 \times 144 \times .371 = 1601. \quad \text{Ans.}$$

$$p_2 v_2 = R T_2$$

$$\therefore T_2 = \frac{p_2 v_2}{R} = \frac{1601 \times 70}{53.37} = 2101^\circ. \quad \text{Ans.}$$

SOLUTION OF THERMOTWISTERS—THIRTEENTH LECTURE.

1. Take Fig. 32 which gives a page from Peabody's Steam and Entropy Tables and connect up all computations for each column as was done in this lecture for Fig. 33.

40   SATURATED STEAM — TABLE I

Temperature, Degrees Fahrenheit t	Pressure, Pounds per Square Inch p	Heat of the Liquid q	Heat of Vaporization r	Heat Equivalent of Internal Work ρ	Heat Equivalent of External Work Apu	Entropy of the Liquid θ	$\frac{r}{T}$	[illegible]	[illegible]	Temperature, Degrees Fahrenheit t
228	20.02	196.5	959.4	885.1	74.3	0.3365	1.39[illegible]	[illegible]	[illegible]	228
229	20.40	197.5	958.7	884.3	74.4	0.[illegible]	1.[illegible]	[illegible]	[illegible]	229
230	20.78	198.5	958.1	883.6	74.[illegible]	0.[illegible]	1.[illegible]	[illegible]	[illegible]	230
231	21.17	199.5	957.4	882.8	74.6	0.3407	1.3866	19.04	0.0525	231
232	21.57	200.5	956.8	882.1	74.7	0.3422	1.[illegible]	18.[illegible]	0.[illegible]	232
233	21.97	201.5	956.1	881.3	74.8	[illegible]	[illegible]	18.[illegible]	0.0544	233
234	22.38	202.5	955.4	880.6	74.8	0.[illegible]	[illegible]	[illegible]	0.05[illegible]	234

Fig. 32. Page from Peabody's Steam and Entropy Tables.

Let us take line corresponding to 231° F. in column one. From column two we read that at 231° F. saturated steam has a pressure of 21.17 lb. per sq. inch abs. This would correspond to 6.47 lb. gauge.

From column three we read that q is 199.5 B.t.u., which means that by experiment it has been found that 199.5 B.t.u. are required to raise 1 lb. of water from 32° F. to 231° F.

From column four we find that r is 957.4 B.t.u., which means that by experiment it has been found that 957.4 B.t.u. are required to evaporate 1 lb. of water at 231° F. into saturated steam at 231° F.

From column five we are informed that ρ has a value of 882.8 B.t.u., which informs us that although we have just found 957.4 B.t.u. required to evaporate 1 lb. of water at 231° F. into saturated steam at 231° F., yet only 882.8 B.t.u. still remain in the steam in the form of internal energy, and as a consequence in considerations of the [illegible] expansion use of steam, this would be the value to use.

Column six states that of the heat required to evaporate a pound of water at 231° F. into saturated steam at 231° F. 74.6 B.t.u. are necessary to overcome external work as the water expands into saturated steam. We have treated this work performed in expansion under constant pressure as computed by the product of the pressure and volume. This result is in ft. lb. and to convert into B.t.u. we must divide by 778. Or since the pressure is 21.17 × 144 lb. per sq. ft. and the volume 19.04 cu. ft. per lb. we have

$$\text{External work} = \frac{21.17 \times 144 \times 19.04}{778} = 74.6 \text{ B.t.u.}$$

Column seven, headed entropy of liquid, follows at once from its definition.

$$\theta = \log_e \frac{T}{T_1} = 2.306 \log_{10} \left(\frac{231 + 459.4}{32 + 459.4} \right)$$

$$= 2.306 \log_{10} \left(\frac{690.4}{491.4} \right) = 0.3407. \text{ Ans.}$$

Entropy of vaporization, heading column eight, is $\frac{r}{T}$ and equal to

$$\frac{957.4}{459.4 + 231} = \frac{957.4}{690.4} = 1.3866. \text{ Ans.}$$

The ninth column or specific volume is computed from the formula

$$L = T \left(\frac{\Delta p}{\Delta t} \right) (v - v_1)$$

L = r = 957.4, T = 231 + 459.4 = 690.4, Δp is the increase in pressure in lb. per sq. ft. from 230° to 232° or the increase for Δt = 2 and is seen to be 21.17 × 144 − 20.78 × 144 = .79 × 144, v is the quantity s which we desire and v_1 is the volume occupied by 1 lb. of water, which is .016 cu. ft.

$$778 \times 957.4 = 690.4 \left(\frac{.79 \times 144}{2} \right) (s - .016)$$

$$s = \frac{957.4 \times 2 \times 778}{690.4 \times .79 \times 144} + .016 = 19.04. \text{ Ans.}$$

The tenth column is simply the reciprocal of the ninth column, or

$$\frac{1}{19.04} = 0.0525. \text{ Ans.}$$

LIST OF FRANCHISES ABOUT TO EXPIRE IN SAN FRANCISCO.

The following street railway franchises are about to expire in San Francisco. As the success of the Panama-Pacific International Exposition of 1915 largely depends upon the facility of transportation, the disposition of the expired franchises will be [illegible] with much interest not only by engineers and the public at large:

[illegible]

Street	From	To	[illegible]	Date of [illegible]	Term of [illegible]	Order No.
Baker	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1549
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2015
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
California	[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]
Clay	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1026
East	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	W[illegible]	M[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	W[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Franklin	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Greenwich	Baker	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jackson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	M[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jefferson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Larkin	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mason	Washington	Montgomery	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	Jackson	[illegible]	[illegible]	[illegible]	[illegible]
Montgomery	[illegible]	Washington	[illegible]	[illegible]	[illegible]	[illegible]
Presidio (Central Av.)	Jackson	California	[illegible]	[illegible]	[illegible]	1026
Sacramento	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1871
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1026
Seventh Av.	California	Golden Gate [illegible]	[illegible]	[illegible]	[illegible]	1026
Steiner	Jackson	Washington	[illegible]	[illegible]	[illegible]	1871
Stockton	Clay	Washington	[illegible]	[illegible]	[illegible]	1026
2d Avenue	[illegible]	Lake	[illegible]	[illegible]	25	1883
						1549
Union	Montgomery [illegible]	Steiner	[illegible]	[illegible]	[illegible]	2015
	Steiner	Baker	[illegible]	[illegible]	[illegible]	2015
Vallejo	Larkin	Franklin	[illegible]	[illegible]	[illegible]	1547ns
Washington	Steiner	Battery	[illegible]	[illegible]	[illegible]	1871
						1549
	Sansome	East	[illegible]	[illegible]	[illegible]	2015

PRECIPITATION, ALTITUDE, AND GRADIENT IN THE SIERRA NEVADAS.

BY WILHELM KREBS, GROSSFLOTTBEK (HOLSTEIN).

The article of Mr. Charles. H Lee[1] on the exemplary studies made by the Los Angeles Aqueduct officials, on Precipitation and Altitude in the Sierras, was extraordinarily interesting to me due to one of its conclusions: "The general slope of the country seems to have more to do with the amount of precipitation than does altitude."

In the "Versammlung Deutscher Naturforesher und Aerzte"[2] 1904, at Breslau, I expressed a similar conclusion: "The formation of precipitation depends more on the gradient of a slope than on the difference of altitude." This conclusion is more radical than that of Mr. Lee, but it is verified by observations made under suitable conditions in different parts of the world. Most convincing of these observations are those granting control by valuation. I beg permission for a short communication of such observations published by me in the "Deutsche Rundschaufur Geographie und Statistik" of August, 1890[3] and of September 1908[4]. (Wien, A. Hartlebens Verlag.)

Table I. Slope of the Storm and Draken Mountains in South Africa directed ahead to the prevailing atmospheric drift in the Rains.

	I	II	III	IV.
Name of Station.	Distance from Coast.	Elevation above sea level.	Gradient from Coast II:I	Amt. of mean seasonal precipitation.
1. King Williams Town	45 km.	400 m.	0.0089	639 mm.
2. Cathcart	110 km.	1200 m.	0.0109	769 mm.
3. Queenstown	160 km.	1070 m.	0 0067	507 mm.
4. Meritzburg	64 km.	640 m.	0.0100	743 mm.

Ratio of	Elevations. II.	Precipitations. IV.	Gradients of slope. III.
1. K. W. T. :2 Cathcart	1:3.0	1.:1.2	1:1.2
3. Qu. .2 Cathcart	1.5:1.0	1:1.5	1:1.5
1. K. W. T. :4 Mar.	1:1.6	1:1.2	1:1.1
3. Qu. :1 K. W. T.	3.6:1.0	1:1.3	1:1.3
4. Mar. :2 Cathcart	1:1.7	1:1.09	1:1.03

Ratio of	Elevations. II.	Precipitations. III.	Gradients of Slope. IV.
3. Qu. :1 Mar.	2.5 : 1.0	1 : 1.5	1 : 1.5

Table II. Eastern Slope of the Cordillera Santo Thomas, Cuzon.

	I.	II.	III.	IV.
Name of Station.	Distance from Coast.	Elevation above sea level.	Gradient from Coast.	Amount of mean seasonal precipitation.
Bayombong	98 km	253 m.	0.0026	1183
Baguio	110 km.	1456 m.	0.0104	1293

Ratio of	Elevations. II	Precipitations. III.	Gradients of slope. IV.
Bay : Bag.	1 : 5.8	1 : 3.6	1 : 4.0

It is evident from Tables I and II that the ratio of precipitations in these cases agrees in a very high degree with the gradients of slope and differs in a high degree from the ratio of elevations.

Cases of such nature occur also on the sea-side slopes of the Sierra Nevada. I have chosen the best situated three stations of the Central Pacific group and of the Mokelumne Group and calculated in the same manner. Indeed the best site for such studies is the most exposed to that side in a middle level. As starting line of the gradient, were chosen not the sea-coast but the swampy banks of the Sacramento River, represented by Sacramento, and of the San Joaquin River, represented by Stockton.

Table III. Central Pacific Group of Stations on the sea-side of the Sierra.

	1.	II.	III	IV.
Name of Station.	Distance from Sacramento.	Elevation above Sacramento.	Gradient from	Amt. of mean seasonal precipitation.
1. Auburn	48,870 km.	393 m.	0.0080	34.93 inches
2. Gold Run	78,519 km.	961 m.	0.0122	54.49 inches
3. Blue Canyon	94,125 km.	1410 m.	0.0150	72.82 inches

Ratio of	Elevations. II.	Precipitations. III	Gradients of slope. IV.
1. Auburn : 2. Gold Run	1 : 2.4	1 : 1.6	1 : 1.5
1. Auburn : 3. Blue Canyon	1 : 3.6	1 : 2.1	1 : 1.9
2. G. Run : 3. Blue Canyon	1 : 1.5	1 : 1.3	1 : 1.2

Table IV. Mokelumne Group of Stations on the sea-side of the Sierra.

	I.	II.	III.	IV.
Name of Station.	Distance from Stockton.	Elevation above Stockton.	Gradient from II : I	Amount of meani seasonal precipitation
1. Mokelumne Hill	65,969 km.	160 m.	0.0070	32.58 ins.
2. West Point	84,955 km.	847 m.	0.0100	42.50 ins.
3. Bear Valley Res.	116,653 km.	1762 m.	0.0151	63.35 ins.

Ratio of	II. Elevations.	III. Precipitations.	Gradients IV. of slope.
1. Mok. H. : 2. West P.	1 : 1.8	1 : 1.3	1 : 1.4
1. Mok. H. : 3. Bear V. R.	1 : 3.8	1 : 2.0	1 : 2.2
2. West P. : 3. Bear V. R.	1 : 2.0	1 : 1.5	1 : 1.5

The law above set forth is very evident from the Sierra stations of Tables III and IV. Application of the reduced precipitations causes only few slight variations of the law. Here I do not emphasize the scientific importance of such results but I insist upon their practical value. For instance I desire to hint at two possibilities revealed by the law: 1st. To find out the critical zone of precipitations on a mountain only by means of a simple profilation of its topographic map. 2d. To find out independent values of precipitation on the crest of the Sierra by applying this law to the Taboose Group, the Oak Group and the Bears Group of Precipitation Gages.

1. Journal of Electricity, Power and Gas, July 8, 1911, page 23.

2. Verhandlungen der Gesellschaft Deutscher Naturforcher und Aerzte 76. Versammlung fer Breslau, 18.-24. September, 1904. Leipzig, F. C. W. Vogel's Verlag, 1905, II, 1 p. 215. The concluded law is employed by me on page 223 of the same publication to explain the doubling of precipitation on the outskirts of a tall timber forest, observed by Professor F. Schubert of the Forest-Academy, Eberswalde.

3. W. Krebs: Uberdas Klima des aussertropischen Sudaprika L. c. p. 495.

4. W. Krebs: Die Niederschliagsverhaltuisse der Phillippinen, l. c. p. 535.

RADIOTELEGRAPHY IN URAGUAY.

Having permanently closed the private wireless-telegraph stations at Punta del Este and El Cerro, the Uruguayan Government has established one at Cerrito, the radius of which covers the whole territory of the Republic and extends for an equal distance over the ocean. The service opened for business on December 15, 1911.

There are 19 other stations in various parts of the Republic, those at Paso del Toros, Rivera, Flores Island, and the English Bank Lighthouse being stationary, the others being installed on the Government war vessels, and 9 portable ones.

The station at Cerrito is connected with the central post office by an underground cable, over which all wireless messages are received and then delivered to the persons addressed.

It is estimated that the annual expense of the system will be $24,000, the receipts being about the same. The tariff is 10 cents per word, with a minimum of 20 words.

NOTES ON REVISED COEFFICIENTS OF FRICTION FOR PIPES.

BY JOS. N. LE CONTE.

Williams & Hazen have published in their excellent little treatise a number of coefficients found in the flow of water through pipes. Their law is

$$v = c\, r^{0.63}\, S^{0.54}\, 0.001^{-0.04} \quad \ldots\ldots (1)$$

in which v is the velocity of the water in feet per sec., c is a constant, s is the slope or drop in the hydraulic gradient per foot.

As these new constants have been accurately determined by experiment it is interesting and instructive to deduce from them revised values of λ in order to apply the equations ordinarily used in pipe computation.

Now by the old familiar formula

$$s = \lambda \frac{1}{d} \frac{v^2}{2g} \quad \ldots\ldots\ldots\ldots (2)$$

In formula (1) let us substitute a value of 100 for c and a value of $r = \frac{d}{4}$ for the hydraulic radius of a pipe. This will give us the equation

$$v = 100 \left(\frac{d}{4}\right)^{0.63} s^{0.54}\, 0.001^{-0.04} \quad \ldots\ldots (3)$$

and if we now substitute for l in equation (2) a length of one foot we have

$$s = \lambda \frac{v^2}{64.4d} = 0.01553 \frac{v^2}{d} \lambda \quad \ldots\ldots (4)$$

Equating values in equations (3) and (4) thereby eliminating s, we have

$$.0006 \frac{v^{1.85}}{d^{1.166}} = \lambda\, .01553 \frac{v^2}{d}$$

$$\lambda = .0387 \frac{1}{v^{0.15}\, d^{0.166}}$$

The following values of λ have been computed by substituting in this last formula data obtained from the new and revised experiments of Williams & Hazen:

VALUES OF λ

Diam in.	(1.048) 1"	(1.380) 1¼"	(1.611) 1½"	2"	2½"	3"
Area Sq. ft.	.00598	.01038	.01315	.02182	.04909	.04909
Vel. ft. sec.	VALUES OF λ					
.1	.0830	.0790	.0770	.0741	.0711	.0690
.3	.0700	.0669	.0650	.0628	.0602	.0586
.5	.0649	.0620	.0602	.0581	.0558	.0541
.75	.0611	.0582	.0568	.0548	.0525	.0510
1.0	.0584	.0558	.0542	.0524	.0502	.0484
1.5	.0550	.0525	.0511	.0494	.0474	.0460
2.0	.0527	.0502	.0490	.0472	.0454	.0441
2.5	.0510	.0487	.0474	.0458	.0439	.0427
3.0	.0496	.0473	.0461	.0445	.0428	.0415
3.5	.0484	.0462	.0450	.0435	.0418	.0405
4.0	.0475	.0452	.0441	.0426	.0409	.0397
5.0	.0460	.0438	.0427	.0412	.0395	.0385
6.0	.0447	.0427	.0416	.0400	.0385	.0374
7.0	.0437	.0417	.0405	.0392	.0376	.0365
8.0	.0429	.0409	.0598	.0384	.0369	.0359
10.0	.0414	.0395	.0385	.0371	.0357	.0347
12.0				.0360	.0347	.0337
16.0				.0344	.0331	.0322

Diam. in	4"	6"	8"	10"	12"	14"
Area Sq. ft.	.08726	.1963	.3491	.5454	.7854	.11069
Vel. ft. sec	VALUE OF λ					
.1	.0662	.0620	.0610	.0579	.0549	.0538
.1	.0560	.0525	.0514	.0489	.0465	.0455
.5	.0520	.0484	.0461	.0445	.0430	.0420
.75	.0488	.0455	.0433	.0418	.0403	.0395
1.0	.0466	.0435	.0415	.0401	.0387	.0379
1.5	.0440	.0410	.0390	.0377	.0365	.0357
2.0	.0410	.0392	.0374	.0361	.0349	.0341
2.5	.0403	.0379	.0362	.0350	.0337	.0330
3.0	.0396	.0369	.0351	.0340	.0328	.0321
3.5	.0387	.0360	.0343	.0332	.0320	.0313
4.0	.0379	.0353	.0337	.0326	.0315	.0308
5.0	.0367	.0342	.0325	.0315	.0304	.0297
6.0	.0357	.0332	.0317	.0307	.0296	.0290
7.0	.0349	.0325	.0310	.0300	.0289	.0283
8.0	.0342	.0318	.0303	.0294	.0284	.0278
10.0	.0331	.0309	.0294	.0284	.0274	.0268
12.0	.0321	.0296	.0285	.0276	.0266	.0260
16.0	.0307	.0283	.0273	.0264	.0255	.0249
20.0	.0296	.0273	.0264	.0355	.0246	.0241

Diam. in.	16"	18"	20"	24"	30"
Area Sq. ft.	1.396	1.767	2.182	3.142	4.909
Vel ft. sec	VALUE OF λ				
.1	.0526	.0515	.0507	.0491	.0473
.3	.0446	.0436	.0429	.0416	.0400
.5	.0411	.0401	.0395	.0384	.0469
.75	.0386	.0378	.0372	.0361	.0347
1.0	.0370	.0362	.0356	.0345	.0352
1.5	.0348	.0340	.0335	.0325	.0312
2.0	.0334	.0326	.0321	.0311	.0299
2.5	.0322	.0315	.0310	.0300	.0289
3.0	.0314	.0307	.0302	.0292	.0281
3.5	.0306	.0299	.0295	.0286	.0275
4.0	.0301	.0294	.0290	.0280	.0269
5	.0411	.0401	.0395	.0384	.0460
6.0	.0283	.0277	.0273	.0263	.0253
7.0	.0276	.0270	.0266	.0258	.0248
8.0	.0271	.0265	.0261	.0252	.0243
10.0	.0262	.0256	.0252	.0244	.0235
12.0	.0254	.0248	.0244	.0237	.0228
16.0	.0244	.0238	.0234	.0227	.0218
20.0	.0235	.0230	.0226	.0219	.0211

Diam in.	36"	42"	48"	54"	60"
Area Sq. ft.	7.068	9.621	12.566	15.904	19.635
Vel ft. sec.	VALUE OF λ				
.1	.0459	.0447	.0439	.0430	.0422
.3	.0388	.0378	.0371	.0369	.0357
.5	.0358	.0349	.0342	.0335	.0329
.75	.0336	.0367	.0321	.0315	.0309
1.0	.0322	.0314	.0307	.0301	.0291
1.5	.0303	.0295	.0289	.0284	.0278
2.0	.0290	.0282	.0277	.0272	.0267
2.5	.0281	.0273	.0267	.0262	.0258
3.0	.0273	.0265	.0260	.0255	.0251
3.5	.0267	.0259	.0254	.0250	.0245
4.0	.0262	.0254	.0249	.0244	.0240
5.0	.0253	.0246	.0241	.0237	.0232
6.0	.0247	.0239	.0234	.0230	.0227
7.0	.0241	.0234	.0229	.0225	.0221
8.0	.0236	.0229	.0224	.0220	.0217
10.0	.0228	.0221	.0217	.0213	.0210
12.0	.0221	.0215	.0211	.0207	.0203
16.0	.0212	.0205	.0201	.0198	.0195
20.0	.0204	.0198	.0194	.0191	.0188

JAPANESE HYDROELECTRIC PLANTS.

Recent Consular reports state that American machinery is in demand in connection with the development of hydroelectric power plants of Japan.

MAMMOTH ELECTRICAL SHOW.

The largest electrical show in the world will be held in Boston in September. The Mechanics building, which will contain it, seats over 100,000 people at one time, and has 105,000 square feet of exhibit space.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
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TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Precipitation Altitude and Gradient

Some months ago there appeared in the columns of the Journal an article by Chas. H. Lee on the relation of precipitation and altitude in the high Sierras. The data used in deducing the conclusions set forth were those compiled by the exhaustive experiments of the hydrographic department of the Los Angeles aqueduct. The general conclusion drawn by Mr. Lee is that the slope of the country seems to have more to do with the amount of precipitation than does the altitude. The article seems to have met with much interested discussion throughout the technical press of the world.

Elsewhere in these columns is to be found a contribution from Wilhelm Krebs, the well-known German expert who has made similar investigations upon other continents than those of America. Mr. Krebs first gives us some interesting deductions from a series of experiments made along the north coast of Africa near the ancient site of the city of Carthage. By comparing the different stations one with the other it is seen at a glance that no uniform law of varying amounts of precipitation with altitudes is possible, but a law based on the gradient—the ratio of the altitude to the distance from the sea-coast or swampy bottom lands—gives at once a uniform and consistant increase of precipitation.

As stated by Mr. Krebs the scientific importance of this law is overshadowed by its practical value. When desiring data on precipitation in an unexplored field, for instance, the precipitation can be quickly determined by comparing the gradient of the new station with that of a neighboring station where complete data are available.

Another feature is of interest, namely that the distance from the sea-coast does not always seem to be the proper beginning point for gradient computation. In the case of the Sierra Nevada Mountains for example, the bottom lands of the great interior basin of California through which drain the San Joaquin and Sacramento rivers, seem to be the proper zero line.

San Francisco Franchises

Elsewhere in these columns will be found details covering some thirty street railway franchises which are about to expire in the city of San Francisco. Speculation is rife among the citizens of that municipality as to the proper attitude to take. The Geary Street railroad in its present situation certainly presents some features which make the serious minded stop to think. It seems most unfortunate that a railroad possessed of every gift of nature such as the Geary Street project should be so hampered by political forces as has been the case during past years.

In the good old days when this railroad was under private ownership it was one of the best money makers in the West and even after the expiration of the franchise the percentage of gross earnings demanded by the city of San Francisco made a handsome return each month for the privilege granted. The slow drifting progress made by the recent city management is a disgrace to the municipality. It is to be hoped that under the cross-fire of the Finance Com-

mittee put forth by the life-saving Rolph administration will at once exert the big stick at the psychological moment, which is now.

It is not the purpose of these columns to favor either private or municipal ownership but suffice it to say that a good energetic private corporation would have had the dividend paying cars racing up and down Geary Street months ago. With an international exposition but three years ahead it behooves every transportation company leading to the Golden Gate metropolis to explode a keg of dynamite and wake up.

The vandalism displayed by the last city government in the changing of cornerstones set by the previous administration, the stringing of trolley wires from house to house, then tearing the same down are but eye-openers to the inefficiency and energy dissipating make-up of the past. The recent enormous deficits brought to light by the investigations of the Finance Company involving over a million dollars certainly show a startling situation in the activities of the Public Works Commission.

Parasites, leaching out the very life blood of the city's financial resources, should be shown the strong arm of the decent element of the city. With every prospect ahead for the greatest era of any city in the history of the world, San Francisco has at once an opportunity to set an example for good government which should not be overlooked. Not the least among these opportunities is that of displaying to the world the most efficient transportation system possible to design by the genius of man.

The city of San Francisco is fortunate in having been able to procure the services of the celebrated traffic expert, Bion J. Arnold. Mr. Arnold is not to be envied in the surgical operation he has ahead. Let us hope, however, that when the surgical operation is completed it will be pronounced a success, not because the patient died under the knife as was recently jocularly exemplified at the Pajama Rally at the California State University, but rather in the sense that all dead portions of the suffering patient be removed and the live healthy portions given every encouragement for future healthy growth.

The Golden Gate City is not the only one interested in the upbuilding of an efficient transportation system for the safe carrying of her people. Nor would we include all interested if the limits were extended to the outward boundaries of the State of California. The entire West looks toward the risen city with eyes of expectancy. A quick and positive solution of the transportation problems for the city of 1915 will add much toward molding those words of national approval which every true Westerner expects to hear in 1916: "San Francisco made good."

Force

We called attention editorially in the last issue of the Journal to the lack of a certain quality in engineering specifications, and that lacking quality we found to be clearness. It is indeed true that of all the characteristics necessary in the presentation of either an engineering project or of a one-meaning specification, clearness, above all else should be the ruling feature. It is to be regretted, however, that so much of our technical literature smacks of its mechanical construction, smells of the oil necessary in its proper lubrication. As a profession, we lack in expression to set forth, what we, as engineers, inwardly feel.

As the engineer looks into the mountain stream he is overcome, often, with the beauty of its clearness and yet its clearness alone would be of but passing interest to our profession; its force is the inner something which touches us to the depths within. And so it is easily seen that while in the writing of specifications and in the drawing up of contracts the ruling characteristic of expression should be clearness, yet when the engineer desires to move men to action his expression in addition to clearness should carry with it the all powerful elements of force.

Let us then in a few words see how this lacking quality may be acquired. In our lighter moments we have learned that "Force is that which lifts Sunny Jim over the fence," and even in times of serious reflection when considering the proper make-up of the engineer's report we find that force is that quality of expression which lifts us above the ordinary humdrum of life into a plane where is to be seen the constructive imagination of the engineer himself. To obtain force in written expression the engineer should bear in mind a unified purpose throughout his report. Each word, each sentence, each paragraph should be so arranged that the eye will readily catch the most important points, and above all there should be in considering throughout the report each element with its neighbors, a clearly defined coherence.

The paragraph may well be said to possess unity if its entire subject matter can be readily expressed in a single sentence. A sentence may be worded in such a way that the important points readily strike the eye by putting at the end the most important word in the sentence. Similarly the last sentence of the paragraph commands attention for the most important points of discussion. Again, force is added by putting the next to the most important parts first in the sentence or paragraph. Coherence is readily obtained in a sentence by grouping together words of like meaning and separating as far as possible words of unlike meaning. Similarly in grouping the sentences of paragraphs by grouping those of like meaning together and separating as far as possible those of unlike meaning coherence is obtained. A careful choice of connectives when these methods fail will aid materially in adding to the expression an unlooked for force.

It is indeed true that great care must be used in exercising such rules as outlined above, for unless [illegible] applied the sentences may take on the appearance of even more mechanical [illegible] than [illegible]. In conclusion let us remember that, above all, the use of figures picturing ideas not expressed [illegible] greatly add to the force of the writing. Such [illegible] seems almost lacking in our present engineering [illegible] in our expression. It is [illegible] of gigantic progress and [illegible] the science of engineering in which mere [illegible] have been foremost may now be sur[illegible] a higher, more forceful literature and [illegible] enrich our engineering life.

PERSONALS.

H. R. Noack, president of Pierson, Roeding & Co., is in the Pacific Northwest.

J. M. Hunt, of Hunt, Mirk & Co., is at Tulare, accompanied by K. G. Dunn.

H. A. Lardner, Pacific Coast manager for J. G. White & Co., is leaving for a Northwestern trip.

J. E. Poingdestre, the Marysville district manager of the Pacific Gas & Electric Company is at San Francisco.

E. C. Ekstromer, Northwest manager for the Van Emon Elevator Company at Vancouver, B. C., is at San Francisco.

A. F. Hockenbeamer, vice-president of the Pacific Gas & Electric Company, has returned to San Francisco after an extensive Eastern trip.

A. Emory Wishon, assistant general manager of the San Joaquin Light and Power Company, with headquarters at Bakersfield, is at San Francisco.

F. G. Baum, of F. G. Baum & Co., who acts as consulting engineer for the Pacific Gas & Electric Company and other large corporations, is at Los Angeles.

J. R. Bibbins is at San Francisco from Chicago to act as chief assistant to Bion J. Arnold in his investigations of the electric traction problems of the city.

H. M. Cooper, manager of the Placer District of the Pacific Gas and Electric Company, with headquarters at East Auburn, was a recent San Francisco visitor.

Wallace W. Briggs, assistant sales manager of the Westinghouse Electric & Manufacturing Company, has been spending a few days at Los Angeles on business.

A. H. Babcock, chief electrical engineer of the Southern Pacific Company, is in the East on business connected with the extension of the company's electric traction lines.

W. E. Mitchell, formerly with the construction department of the General Electric Company's San Francisco office, has joined James Mitchell of New York City in engineering work.

A. J. Myers, the representative of the Wagner Electric Manufactuing Company, for California and Arizona, is at St. Louis, attending the regular annual meeting of the company's district sales managers.

Sidney J. Carr, who was formerly connected with the sales department of the Westinghouse Electric & Manufacturing Company's San Francisco office, is now associated with the Hawaiian Electric Company, Ltd.

J. Q. Brown, chief engineer and purchasing agent for the Oakland Railway Company, is in the East on business connected with the purchase of some new equipment, presumably for the power plant end of the system.

Guy E. Tripp has been elected chairman of the board of directors of the Westinghouse Electric & Manufacturing Company. He is an engineer well known in Seattle as one of the vice-presidents of the Stone & Webster engineering firm.

John Fulton of the Oregon Agricultural College is prepared to give a course in highway chemistry the first of its kind to be offered by any college. The course treats of the various components used in modern highway construction.

T. J. Stacey, vice-president and secretary of the Electric Appliance Company, of Chicago, left on the steamer Mongolia last Tuesday for Honolulu. He was accompanied by his wife and daughter. Their round trip will occupy a month.

James L. Raymur, the Water Commissioner of Victoria, B. C., has arrived at San Francisco for a short stay, with his wife and daughter. As the official in charge of the water works of his city, Raymur is responsible for the contract amounting to $1,116,000 that has just been signed by the Westholme Lumber Company for the construction of the new Sooke Lake water supply system.

Irving H. Sherwood, electric and mechanical engineer, formerly engaged in numerous power enterprises of the Northwest, is now a member of the firm of William S. Turner & Co., consulting engineers, Portland, Ore.

John Reed, civil and hydraulic engineer, formerly with the firm of Joseph H. Sands & Co., Roanoke, Va., as supervising engineer, is now a member of the firm of William S. Turner & Co., consulting engineers, Portland, Ore.

Fred T. Mumma, who has been with the construction department of the General Electric Company's San Francisco office, will leave February 1, to go into the general contracting business for himself. At first his headquarters will be at 5120 Grove street, Oakland.

P. L. Shuffleton, who is representing Stone & Webster in California, in connection with the work in progress on the Big Creek development, is a recent arrival at San Francisco. J. B. Lukes, who represents the firm at Reno, Nev., was also in the city during the past week.

E. N. Sanderson, H. Hobart Porter and Francis Blossom, all members of the New York firm of Sanderson & Porter, are in the Pacific Northwest on an inspection tour. It is expected that they will accompany Wynn Meredith, the Pacific Coast manager of the firm, to San Francisco during the first week in February.

H. M. Dougherty of J. G. White & Co.'s staff, who has headquarters at Los Angeles as superintendent of construction on the Midway Gas Company's proposed pipe line for natural gas, has been spending a few days at San Francisco. W. E. Barrett, the gas engineer of J. G. White & Co., who is also stationed at Los Angeles, has gone to New York for a conference on the details of the Midway Gas project.

ELECTRICAL CONTRACTORS' NOTES.

Hetty Bros. were awarded the electric wiring on the German House, for $6500.

C. V. Schneider, manager of the Electric Supply Company, of Sacramento, was in San Francisco last Thursday on business.

The General Electric Construction Company were awarded wiring of a warehouse for H. Levi at Fifteenth and Kansas streets.

H. B. Woodill, of the Woodill-Hulse Electric Company, Los Angeles, has been appointed Statesman for the Sons of Jove in the South.

Seth Cohn, proprietor of the Atlas Electric Company, of San Mateo, was in San Francisco last Friday. Mr. Cohn is starting a San Francisco office in the Hearst building.

The local branch of the California State Association of Electrical Contractors has filed a protest with the Board of Works against doing any more of the electrical work on the city and county hospital, San Francisco, by day labor.

The estimate on the electric wiring for the Sacramento Armory ran from $1945 to $3250. It is doubtful if the building will go ahead as bids for the entire contract exceeded the amount set aside, by $7428, the lowest bid being $107,438.

Judge Murasky ruled against the Civil Service Commissioners in the cases of Jones and Pendacook, two of the old inspectors of the Department of Electricity who were displaced by the McCarthy administration on trivial charges. As both men are old employes and good inspectors their friends are pleased to hear of the decision in their favor.

OREGON ELECTRICAL CONTRACTORS.

Oregon members of the National Electrical Contractors' Association held a preliminary meeting recently to perfect a State association. Members were present from all principal towns in Oregon. Fred D. Webber, State electrical inspector, acted as chairman. Committees were appointed on constitution and by-laws and membership. The objects of the association are: Fostering trade among the electrical contractors and the promotion of sociability among members.

INDUSTRIAL

WESTINGHOUSE ALTERNATING CURRENT GENERATORS

Waterwheel, alternating current generators of both the vertical and horizontal types are built by the Westinghouse Company. Machines of this type aggregating in capacity over three-quarters of a million kilo-volt amperes have been built by the company, and are in active successful operation.

The speeds of waterwheel generators of a given capacity operating under different conditions may vary so widely that a considerable range must be covered by a line of generators for waterwheel drive. These conditions are entirely unlike those affecting engine driven generators which are built for but a few fairly well standardized speeds. It is, therefore, impossible for the manufacturer to have a complete design for every combination of capacity and speed that may be required, and it is not good engineering practice to use one or two types of rotor construction for machines for the entire range of speed. So the Westinghouse Company has developed numerous types of rotor construction, each one proven in service and standardized.

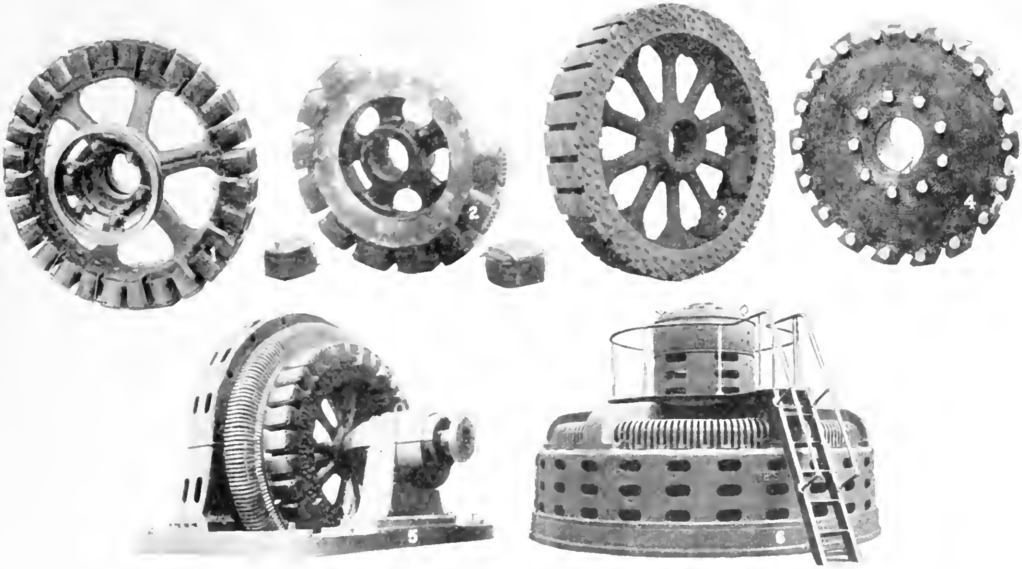


Fig. 1. Waterwheel Generator Rotor, Cast Spider Bolted Poles. Fig. 2. Waterwheel Generator Rotor, Cast Spider Dovetailed Poles. Fig. 3. Waterwheel Generator Rotor, Laminated Rim and Dovetailed Poles. Fig. 4. Complete Waterwheel Generator Rotor, Plate Spider and Dovetailed Poles. Steel Plate Waterwheel Generator Rotor. Horizontal Westinghouse Waterwheel Generator; Frame Shifted Over, Exposing Rotor. Fig. 5. Frame Showing Armature Windings for Westinghouse Horizontal Waterwheel Generators. Fig. 6. Vertical Westinghouse Waterwheel Generator.

Standard Westinghouse waterwheel generators are regularly wound for any of the following voltages: 240, 480, 600, 1200 and 2400. Those of 500 k.v.a capacity and larger are also standardized for 6600 volts. Two-phase or three-phase windings are standard. For single-phase service, generators are supplied having three-phase windings and the single-phase load is carried by any two leads of the three-phase winding. When so connected, a three-phase generator is guaranteed to carry a single-phase load equal to 70 per cent of its three-phase rating.

As previously suggested, it is not consistent with economical and safe construction to use rotors of the same general design for an entire line of waterwheel generators, due to the wide ranges of speed and capacity to be covered. In general the centrifugal stresses are very much higher in rotors turning at high peripheral speeds than in rotors turning at low peripheral speeds. This condition is recognized by the Westinghouse Company, and in developing the line of waterwheel generators, it was found expedient to adopt rotor construction of several different forms. Each is inherently adapted for certain speed and capacity ranges as indicated in the following schedule of the principal types.

The construction of Fig. 1 in which the poles are bolted to the rim of cast iron or steel spider, is adapted for the lowest peripheral speeds such as ordinarily obtain with very low heads of water.

Fig. 2 shows a construction wherein poles are dovetailed to the rim of a cast spider, which is adapted for almost any speed but is limited in its application because of the difficulty of promptly obtaining castings of large diameter. Cast steel spiders are usually required for this construction.

In a construction, Fig. 3, adapted for rotors of large diameter and high speeds a laminated rim is dovetailed to a cross spider and the poles are dovetailed to the rim. This construction is adapted for large diameters and high speeds. A cast steel spider, or the solid plate spider described below, would be satisfactory for these conditions provided the plates or castings of the requisite diameter could be readily obtained. The use of such large castings are, if possible, avoided as they may introduce delays in manufacture.

In another construction that is adapted for the highest speeds, the spider is formed of laminations punched from sheet steel. The maximum diameter of such a rotor is determined by the maximum diameter of laminations that it is

feasible to punch. Over 600 generators having rotors of this type are giving satisfactory service.

Rolled steel plates form spiders of the construction of Fig. 4. The poles are dovetailed to the spider. This arrangement is adapted for the highest speeds. It is evident that it would not be possible to increase the strength of this construction as the rolled steel is absolutely uniform in texture. It is moreover, readily-obtainable, merchant material.

Poles for all Westinghouse waterwheel generators are laminated. The field coils are retained on the poles by overhanging pole tips, and, where the stresses are high, by extra coil supports riveted to the sides of the poles.

Cast iron frames of modified box section, designed for maximum stiffness, support the punchings that form the armature structures of horizontal generators as shown in Fig. 5. Ventilating finger plates are inserted at intervals between the stator laminations and insure cool operation. End plates of cast or wrought iron bind the laminations firmly in position in the stator structure. All armature slots are open and all armature coils are form wound, thoroughly insulated and interchangeable. The armature coils are effectively braced, wherever necessary, at the ends of the frames so that they cannot distort under the action of excessive currents.

Open or ventilating end-bells are used on the smaller Westinghouse horizontal generators. These end-bells are built up from mild steel sections and are rigid and unbreakable. At the same time they are extremely open, assuring that air circulation and cooling air currents will not be materially obstructed. Enclosing end-bells are successfully used on some of the large high-speed horizontal generators. Enclosing end-bells serve to effectively direct the ventilating air and to minimize the hum incidental to the operation of large, high speed generators.

Westinghouse vertical generators are usually provided with two guide bearings. The bearings are babbit lined and lubricated by a continuous flow of oil. The thrust bearing is ordinarily furnished by the waterwheel builder as a part of his equipment, but when the Westinghouse Company furnishes the thrust bearing, it is mounted on the top of the generator. See Fig. 6. A mechanical or motor-driven rotary pump supplies forced lubrication for Westinghouse vertical generators. A bed plate is provided with each generator which is set on the foundation. The generator is accurately aligned, and then firmly clamped to this plate.

TRADE NOTES.

The General Electric Company reports the sale of a centrifugal air compressor to the Great Western Smelting & Refining Company of San Francisco for use with an oil-fired furnace.

The Wagner Electric Manufacturing Company of St. Louis, announce the removal of their San Francisco office to the new Rialto Building, with store entrance 110 New Montgomery street, to continue in charge of Mr. A. J. Myers. The telephone number, Douglass 2139, will be unchanged.

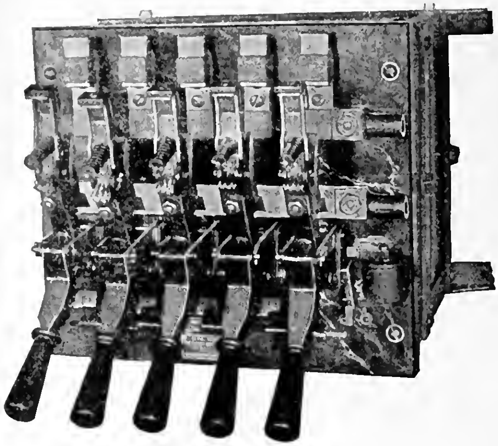
William S. Turner, consulting engineer, of Portland, Ore., has just associated with himself two engineers of note, John Reed, civil and hydraulic engineer, and Irving H. Sherwood, electric and mechanical engineer. A partnership under the firm name of William S. Turner & Co. has been formed to undertake a general engineering practice.

After lengthy consideration, the contracts for the equipment of the San Francisco hydroelectric plant in connection with the Los Angeles Aqueduct, were recently awarded. The Westinghouse Electric & Manufacturing Company secured the three 8,700-kw. generators, which are to have a possible overload capacity of 10,000 kw. each. The Westinghouse Company was also awarded the transformer contract amounting to nearly $100,000. The contract for the water wheels was awarded to the Union Iron Works of San Francisco. The water wheels will be of very heavy construction, the main bearings being 18½ inches in diameter.

The Hawaiian Electric Company, Ltd., which holds the joint agency for the Westinghouse Electric Manufacturing Company and the Pelton Water Wheel Company in the Hawaiian Islands, has secured a contract for a hydroelectric installation from the Maui Agricultural Association. The specifications call for a 1,000-k.v.a. generating set consisting of a 2400-volt Westinghouse generator direct connected to a Pelton-Francis turbine equipped with a Pelton oil pressure governor and operating at 720 r.p.m.

NEW MULTIPLE SWITCH STARTING RHEOSTATS.

For large motors because of the larger currents, starting rheostats of the ordinary sliding contact type are not well adapted. Multiple switch starters, one of a new line manu-



New Cutler-Hammer Multiple Switch Starter.

factured by the Cutler-Hammer Manufacturing Company of Milwaukee is illustrated, are used for cutting out the individual steps of resistance for accelerating the motors. The new switches used on these starters differ from the former types used in that a toggle joint operation permits of closing by pushing the handle downward instead of up. The contact made is quick and absolute. In start the left hand switch is closed first, then the second, third, etc., allowing a second or two between. Each switch, by means of metal stops near the handles, holds the switch before it, in place. When the last switch is closed the No-Voltage Release Magnet holds them all in contact and the entire resistance is short-circuited. The switches cannot be closed out of order and two or three switches, for instance, cannot be closed and the others left open. Releasing the hand from any handle except the last causes all switches to open. The motor cannot run with resistance in the circuit and the resistance is, therefore, also protected from overheating. Overload Release is also included in the various types made.

NEW CATALOGUES.

Sprague Electric Works of the General Electric Company has issued Bulletin 239 which illustrates and describes the Sprague full automatic push button control system for the operation of newspaper presses.

Catalog A from Smith-Booth-Usher Company of Los Angeles is a 576 page volume listing and describing the large line of machinery carried in stock. This includes steam boilers, engines, pumps, air compressors, distillate engines, windmills, transmission machinery, machine tools, mining machinery, concrete and brick machinery, pipe, casings, fittings and valves. The index is most complete, facilitating the purchasers' use.

NEWS NOTES

INCORPORATIONS.

MEDFORD, ORE.—California-Oregon Power Company; capital stock, $10,000,000.

LOS ANGELES, CAL.—Pacific Engineering Company; incorporators, Donald W. Wilson, Ben G. Rowan, A. A. Wilson, R. N. Rogers; capital stock, $10,000; subscribed, $500.

SANTA FE, N. M.—Luna County Telephone Association, of Deming, has been granted a charter, with capital stock of $25,000. The incorporators are: Hugh Ramsey, F. A. L. Taylor, A. L. Taylor. A. A. Tempke is agent, with office at Deming. Will build and operate lines of communication between towns, cities and villages of Luna County.

LOS ANGELES, CAL.—Upland Foothill Water Company has been organized for the purpose of developing water in Ridge Canyon section for irrigation purposes. Capitalized for $89,000. Incorporators are: J. P. Wedel, G. A. Hanson, D. D. Tempe, William Rohrig, C. E. Searles, O. W. Kankel, R. N. Leahy, A. J. Smith, O. L. Galbreth, S. P. Wieger, J. J. Atwood and J. D. Wilson.

ILLUMINATION.

NEWPORT, CAL. The matter of voting bonds for light and power will be ready for action again on June 6th.

CATHLAMET, WASH.—The Council has passed an ordinance granting to J. D. Haycock an electric light franchise.

COLTON, CAL.—The Southern California Gas Company, which is erecting a $75,000 gas plant, bid in the franchise to lay gas mains in the city of Colton.

BOISE, IDAHO—The Boise Gas Light Company will increase the size of its plant four times and lay about 10 miles of new mains, it expects to spend $75,000.

ELLENSBURG, WASH.—J. A. Crimp, City Clerk, is advertising for bids on 124 three-cluster light poles, with shade holders and foundation bolts. Bids will be opened February 5, 1912.

ABERDEEN, WASH.—The City Council has accepted the Grays Harbor Railway and Light Company's offer to add 295 tungsten lights to the city's lighting system at $2.25 a month for each light.

PORT TOWNSEND, WASH.—The Council has passed an ordinance granting to the Olympia Power Company the authority to erect poles and wires across certain streets in the city for the purpose of transmitting electric current.

ELLENSBURG, WASH.—S. Bornstein of Seattle has made application for a 50-year gas franchise. Mr. Bornstein offers to pay the city a gradually increasing percentage of the gross receipts, starting with one-half of 1 per cent and increasing to 2 per cent.

LYNDEN, WASH.—Albert F. Cooke, said to represent Smith, Cary & Chase, Toronto engineers, has applied to the City Council for an electric light franchise. W. H. Waples, of Waples Shingle Mill, and at present furnishing the city with light, is also asking for a new lighting contract. Both applications have been before the Council some time.

OAKLAND, CAL.—The Mono Power Company of Oakland yesterday filed a certificate of creation of bonded indebtedness in the sum of $2,500,000. The bonds are 30-year 6-per cent interest, payable semi-annually, and redeemable at 105 per cent of their par value, with accrued interest, on and after December 15, 1916. The company is incorporated for $3,000,000, with 30,000 shares of a par value of $100 each. The directors are J. J. Quinn, Leon M. Hall, I. H. Clay, Fred L. Dreher and H. A. Mosher.

TRANSPORTATION.

CALDWEL, IDAHO—The interurban electric road will be extended this year from Caldwell to Weiser.

TWIN FALLS, IDAHO—Work has started on an electric line from Gooding to Oakley, via Jerome and Milner.

KLAMATH, ORE.—It is reported that an electric line will be built this year to connect Klamath with Lakeview.

NEWBERG, ORE.—The Southern Pacific and Oregon Electric have secured a franchise to lay a single-track electric road on First street.

VANCOUVER, B. C.—The British Columbia Railway has announced that it will double the size of its production plant at a cost of $4,000,000.

SALEM, ORE.—An electric line from here to Mehama seems assured. It is estimated the line will cost $301,000 and will be $17\frac{1}{2}$ miles in length.

LOS ANGELES, CAL.—E. D. Goode, railroad builder, has applied for a franchise for an electric railroad to connect Glendale with Griffith Park.

FERNIE, B. C.—Application has been made to the government for permission to construct an electric railway from Cowley to Crow's Nest Lake, a distance of 25 miles. W. A. Beebe is acting for the applicants.

LEBANON, ORE.—Engineering headquarters have been established here by E. S. Clark and a crew of ten assistants from Walla Walla, who will make a survey for an electric road up the South Fork of the Santiam.

LOS ANGELES, CAL.—The Council has granted permission for the Santa Monica airline to be changed from steam to electric. Life of franchise will be limited to twenty-one years and transfer arrangement has been improved.

VANCOUVER, B. C.—The British Columbia Railway has announced that it will double the size of its production plant this year, so that by January 1, 1913, 105,000 horsepower will be available. The work will cost from three to four millions.

PASADENA, CAL.—The Southern Pacific Railroad Company has applied to the City Council for a franchise to electrify its system from the Southern Pacific Depot on Colorado street along Broadway to the city limits. The request will be granted.

LODI, CAL. Surveyors have been running lines in the hills between Lockeford and Jackson for several weeks, and there are indications that the Central California Traction Company may extend its proposed branch line to Lockeford on to Jackson and possibly to San Andreas.

STOCKTON, CAL. The amended articles of incorporation of the Oakland, Antioch and Electric Railway Company have been filed and reports are that the work of constructing the railroad will commence in the near future. The company, which is being financed by San Francisco capitalists, is preparing to run a line from Oakland to Sacramento through Alameda, Contra Costa, Solano, Yolo and Sacramento counties, with a branch line running between Antioch and this city. The entire length of the road will be approximately 120 miles.

DALLAS, ORE.—At a meeting of the Dallas Commercial Club last night, steps were taken to join in the movement being put forward to get the proposed electric line to McMinnville extended through Polk and Benton counties to Corvallis and then on to Eugene.

STOCKTON, CAL.—The Tidewater and Southern Railroad has been granted a franchise to operate an electric road over Pilgrim street from South street to Scotas street and along Scotts avenue to East street. It provides for double tracks, the use of T-rails and the sprinkling of the streets on which it runs. It is required that the railroad be in operation within two years.

SEATTLE, WASH.—Three bids were received by the Board of Public Works for the construction of a municipal street railway 4½ miles long, double track except 3000 feet at the north end. Jahn Construction Company bid $148,941; Graf Construction Company, $163,000, and Stillwell Bros., $175,000. First two want cash, but the last named accepts bonds if such are held to be legal.

RICHMOND, CAL.—Engineers for the United Properties Company have begun making a survey for the double tracks ot the East Shore Suburban Railway between this place and Oakland. Shortly after the traction line was purchased by the $200,000,000 corporation and combined with the Key Route and Oakland Traction Company, it was promised that the entire line would soon be double-tracked and a faster schedule provided.

PORTLAND, ORE.—The Southern Pacific will soon commence the electrification of the Fourth-street line and a part of the Yamhill division as far south as McMinnville, embracing approximately 100 miles of tracks. D. W. Campbell, general superintendent of the lines in Oregon and Northern California, states that plans for all the work have been completed, and as soon as the necessary franchises are obtained in Hillsboro and in Portland, actual work will be started.

TRANSMISSION.

STEVENSON, WASH.—The Northwestern Electric Company has been granted a franchise to erect electric power lines on county roads.

TACOMA, WASH.—The Seattle-Tacoma Power Company will put up a second high tension line to the Tacoma Smelter at an estimated cost of $10,000.

BROWNSVILLE, ORE.—The Oregon Power Company is extending its lines on Walnut avenue and Main street. More work of the same kind will follow.

LIBBY, MONT.—The Kootenai Falls power project is assured, the final steps having been taken by the backers. The total cost of plant is estimated at $6,000,000, with generation of 100,000 horsepower.

SAN FRANCISCO, CAL.—The Great Western Power Company's 11,000-volt submarine cable connecting San Francisco with the Oakland side of the bay was successfully laid January 23d from a steel barge built for the purpose.

FREEWATER, ORE.—The construction of 10 miles of power line costing $9500, and supplying 15 customers, with a total of 108 horsepower, has just been authorized by the main office of the Pacific Power and Light Company in Portland.

SAN FRANCISCO, CAL.—The Great Western Power Company has been granted a temporary permit for the use of a reservoir and power site on the National forest and public lands in connection with its Feather River project. This is the site of the Big Meadows Reservoir now under construction.

PORT TOWNSEND, WASH.—The Irondale Electric and Power Company has been granted the desired franchise to act as distributor of power from the Olympic Power Company in a large section of country extending from the Clallam County line through practically all the settlements in the county lying north of Quilcone.

BELLINGHAM, WASH.—Smith, Kerry & Chace, a Toronto firm of capitalists, have bought land west of here for a power plant site. Water rights on the middle fork of the Nooksack River have been acquired by the company and it is said power will be generated for the use of the big Balfour-Guthrie cement plant, now being erected.

LYLE, WASH.—Judge H. E. McKenney has decided the case of the Northwest Electric Company against the squaw Emma Dave and other claimants. The decision held that the deposit of the petitioner was ample for all damages that might accrue, and the Northwest Electric Company could proceed to develop the water power of the Big Klickitat River.

TELEPHONE AND TELEGRAPH.

PULLMAN, WASH.—A new telephone franchise has been granted the company here.

BOISE, IDAHO—Mountain States Telephone and Telegraph Company will spend $300,000 rehabilitating its system.

OLYMPIA, WASH.—The Postal Telegraph Company is making preparations to rebuild its line between Olympia and Tenino.

HOQUIAM, WASH.—Telephone lines between here and Moclips and Pacific Beach, also between Aberdeen and Cohasset, are being talked of.

SOUTH PASADENA, CAL.—A. B. Cass, president of the Home Telephone Company, announces that a separate exchange will be provided in the near future.

RED BLUFF, CAL.—The Tehama County Telephone Company has decided to extend its lines further into the country districts and to continue work on the long-distance connections.

CHEHALIS, WASH.—Permission has been granted by the Board to set telephone posts and string wires over the county roads from Morton to Riffe, in accordance with application made by the Highland Valley Telephone Company, a new concern which has just organized. E. C. Coombs of Morton is the president.

POMONA, CAL.—Because of the large increase in its long-distance business, during the last few months, there has been installed at the local Home Telephone Company's building a new "four-position" long-distance switchboard. The facilities of the long-distance department of the company have been doubled by the addition of this new equipment The long-distance office has been moved to the first floor of the building north of the First National Bank.

WATERWORKS.

HOLTVILLE, CAL.—The city has incurred a bonded indebtedness of $8000 for completing water works system.

WHITTIER, CAL.—The City Trustees have decided to spend $11,000 on improvement of the city water system.

GRANTS PASS, ORE.—The Crystal Springs Water Company will extend a pipe line from the mountains three miles north of the city into Grants Pass.

MEDFORD, ORE.—The Jacobson-Bade Company has been awarded the contract for putting in the entire distributing system for the Jacksonville new water system. Price to be paid for the work is $27,000.

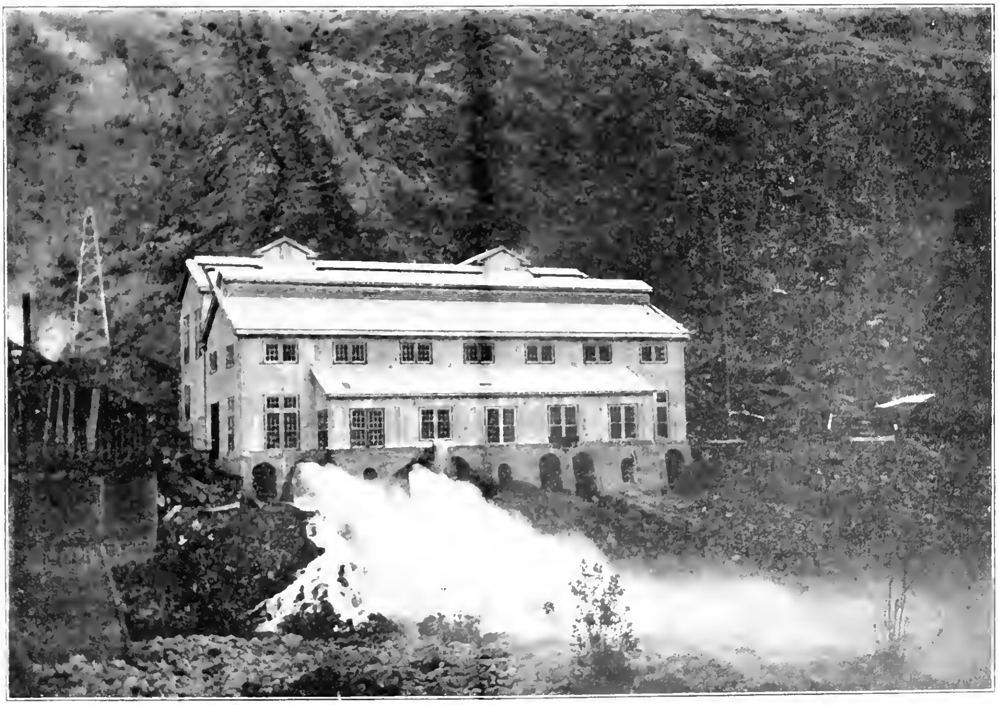
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, FEBRUARY 3, 1912 | NUMBER 5

THE CONSTRUCTION OF THE STANISLAUS LINE[1]

BY H. W. CROZIER.[2]

The transmission line of the Sierra & San Francisco Power Company is usually known as the Stanislaus line, on account of the fact that it transmits power developed on the Stanislaus River. A description of the line, some of the details and its construction will perhaps be of interest.



Generating Station of the Sierra and San Francisco Power Company on Stanislaus River

The line is built primarily to transmit power from the power station on the Stanislaus River to San Francisco, where the power is delivered to the United Railroads who require from 16,000 to 20,000 kw. On account of the fact that San Francisco is located on a peninsula a considerable divergence from a direct line was necessary in laying out the transmission line on account of the necessity of going around the southern end of San Francisco Bay. The line, however, is about 134 miles long and is the shortest transmission line now delivering power into San Francisco.

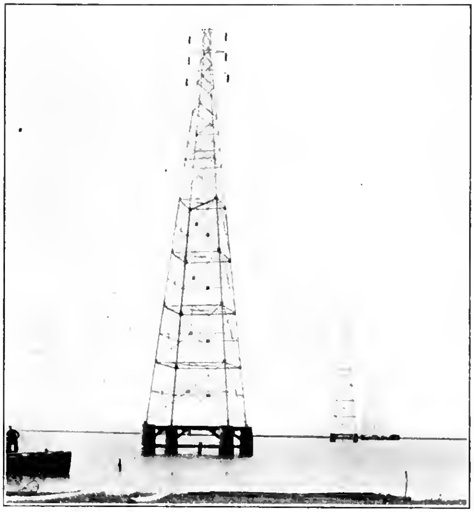
The construction of the line is of a very substantial character. Stranded copper conductors of an area equivalent to 00 are used to conduct the current, supported by suspension type insulators attached to steel towers.

In level ground the towers are high enough to support the lowest conductor 50 ft. above the ground at the tower, and the towers are spaced 800 ft. apart. In hilly or mountainous ground, advantage is taken of

[1]Paper presented before San Francisco Section, A. I. E. E., Jan. 26, 1912.

[2]With Sanderson & Porter.

the inequalities of the ground, longer spans are used where convenient and shorter towers on the hill tops. The wires are given a clearance of 25 ft. at the closest point.



Transmission Line Crossing San Francisco Bay South of Dumbarton Cut-Off.

Bay Crossing.

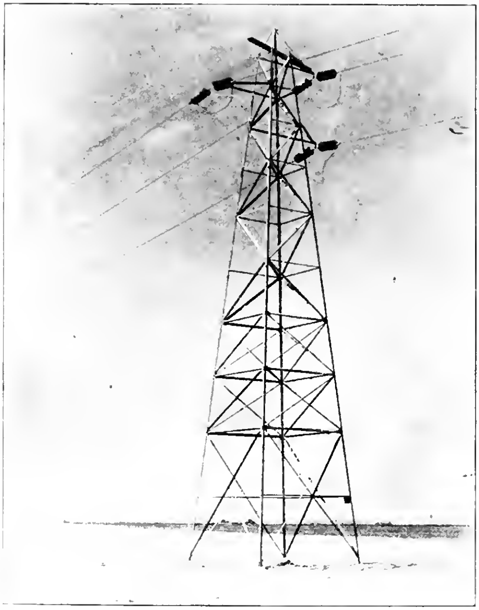
In determining the location of the line three different routes could be followed; one, crossing the bay at the Dumbarton Point close to where the Southern Pacific Railroad crosses the bay; another, further south and skirting the marshy margins of the bay; and the third, further south again but on more solid ground and parallel to the route followed by the Pacific Gas & Electric Company's transmission line, built a number of years ago. At Dumbarton Point the distance from shore to shore is considerable, about 6000 ft. The shores are flat marshy ground and there are no hills or even solid ground at all in the vicinity. The type of crossing used at Carquinez Straits was out of the question. It would be necessary to erect towers and anchors in the marshy ground on pile foundations. Surveys of the channel were made and consideration of the kind of towers and foundations gone into in detail. It was found that a 3500 ft. span would be required with two high towers, or somewhat shorter spans could be used by making one central high tower with two lower towers in the shallower water in shore. Estimates were prepared on this basis and much consideration given to the foundations required.

The long span required, the heavy current, and the deep water in which the foundations would have to be placed, made the estimates run up to a high figure. Before proceeding at Dumbarton, an investigation was started in the swamp ground on the southern end of the Bay to see if in the end it would not be cheaper and better to cross the bay at the mouth of Coyote Slough and build along the swampy ground.

This investigation immediately disclosed the fact that the crossing would be in not to exceed 27 ft. of water, and standard spans of 800 ft. previously determined on for solid ground could be used. Although the line would be nearly three miles longer, the cost of the construction was found to be very favorable, and even with the line loss and extra cost of the longer line capitalized, the estimated cost was considerably less than that of the Dumbarton Crossing. Final decision was made therefore for a line running around the southern end of the bay for the following reasons:

1. Standard tower construction same as rest of line.
2. No strain anchors for long spans.
3. Towers 162½ ft. high against 210 ft. for long span.
4. Much lighter towers on account of reduced span.
5. Lighter foundations on account of lighter towers and shallower water.
6. Practically no danger from collisions with vessels.
7. The Dumbarton Crossing has a very strong tide and vessels approaching the railroad drawbridge are difficult to handle at some stages.

The line finally used skirts the marshy margin of the bay and crosses the Coyote Slough at its mouth, and also another minor slough, the total distance being 2700 ft. Four towers were erected at this point on concrete and pile foundations. Each foundation consists of four piers containing four piles each, making 16



Strain Insulators on Transmission Tower.

piles for each foundation. The piles are surrounded by a cassion, which after being driven into a hard layer in the bottom of the bay, was pumped out, material dredged to a safe distance below the bottom, and the hole filled with concrete, suitably reinforced with steel rings and with vertical rods. On the four cylinders thus erected a structural steel frame work was built and the whole when completed was encased

in concrete, making a four legged structure containing piles which go to considerable depth and firmly braced with structural steel protected by concrete. Upon this structure was erected the towers.

Most of the craft navigating this part of San Francisco Bay are small, consisting of scow schooners, power schooners and launches. No damage is expected from collisions with these vessels, as the concrete foundations are undoubtedly strong enough to resist collision with very much larger vessels. The transmission line clears the water at high tide by 120 ft., which is ample for any vessels navigating these waters.

In addition to the crossing of the Alviso Slough there were a number of other sloughs of more or less importance which were crossed, and which it was decided by the U. S. Engineers would require clearance in some cases of 120 ft., and in other cases of 90 ft. The foundations, however, were on the banks of the sloughs and have been previously described. The towers were similar to the ones used at the Alviso Crossing, consisting of a standard 50 ft. tower with a 62½ ft. extension where 90 ft. clearance was required, and 87½ ft. extension where 120 ft. was required.

In the erection of the line on the marshes it was not possible to use horses on account of the soft character of the ground. The bay, however, made it possible to use launches and barges on which donkey engines could be mounted. Transportation was convenient and the long stretches of marsh were crossed by donkey engines mounted on skids, which by their own power hauled themselves along. It is estimated that perhaps in the end the cost of hauling the material to the site and erection of the line is not any more than would have cost on more solid ground after we except, of course, the cost of the erection of the foundations which would not have been required on solid ground.

A word about the operation. The power station has been in operation for three years; the transmission line into San Francisco for 15 months. The high grade of the service given can be easily seen in the much more reliable service now given by the United Railroads, than before this system supplied their needs. All complaints on account of delayed cars, about which the newspapers usually had something every day or so, have entirely stopped. From an authoritative source it is learned that the total interruptions to service during the year 1911 for the whole system covering hydraulic, transmission and all other causes amounted to 24 hours. This is certainly an excellent record and it is known that a very small part of these 24 hours is chargeable directly to transmission line.

Insulator troubles on this line have been nil, first due to the design, and second, to the very careful inspection which the insulators were given in the factory and after erection. The insulation provided is undoubtedly ample, and no trouble whatever has been had due to fogs. The few interruptions during 1911 were caused by occurrences beyond the control of the company, one due to a boy climbing a tower, and the others to interference in one way or another.

The towers: The towers were manufactured by the Aermotor Company of Chicago. They consist of four corner angles connected by horizontal girts and by diagonals, and supporting three double crossarms. No part of the tower is less than ⅛ in. thick, and no rods are used than ½ in. diameter; ¾ in. and ⅞ in. bolts at crossing of diagonals and other unimportant points.

There are three joints in the vertical angles dividing the tower into four parts, each approximately 15 ft. long. By leaving off the lower 15 ft. a shorter tower is obtained which is used in the hilly country.

The conductors are supported in two vertical rows of three each. The rows are 15 ft. apart and the conductors are 9 ft. apart vertically.

Foundations: A steel foundation for each leg is used, consisting of two 3 in. x 2½ in. x ¼ in. angles 6 ft. 6 in. long, on the end of which, and at right angles, is fastened a 12 in. channel 2 ft. long. These foundations are placed in a hole excavated for the purpose and well tamped.

Line Transposition.

Galvanizing: All parts of the towers are galvanized by the hot process and will stand the tests prescribed in the Western Union specifications for galvanized wire.

Erection: The towers as received at the railroad station consist of a lot of angles, rods, and for each

tower a box of bolts and other small detail parts. This material is hauled to the sites selected for the tower. A careful man is put in charge of this work, as it is quite easy to forget some essential part. All the parts

Insulator Arcing at 205,000 Volts in Rain Test.

are well marked with numbers and a printed list furnished by the Aermotor Company, so that with care no difficulty is experienced in handling the material. The four holes for the foundation are dug and the foundation parts installed with the aid of a steel template. The excavated material is shoveled in the hole again and tamped like any other work.

The tower is assembled first by putting together the sides on the ground, standing them on edge, and then bolting on the remaining pieces. Every part except the insulators is installed on the towers on the ground.

Erection: The tower perviously assembled is moved to the foundations, the ends of which are projecting above the ground. A piece of pipe with brackets riveted on it to bolt to the legs of the tower, is laid against the foundations and acts as a trunnion during hoisting of the tower. A steel cable is attached to the tower near the top and let over a gin pole, which stands up at the base of the tower. Blocks are attached to this steel cable and anchored about 400 ft. ahead to steel gads driven in the ground, or if the ground is too soft, to a dead man, previously buried. A line is also fastened to the tower and carried back to act as a back guy. When all is ready a team is hitched to the blocks and the tower hoisted, the gin pole dropping out as soon as the top of the tower has moved upward about 20 ft. The tower properly restrained by the back guy is attached to two of the foundations and bolted up and then after the pipe is removed from the two back foundations, a slight additional pull raises the back legs of the tower and these are bolted in place.

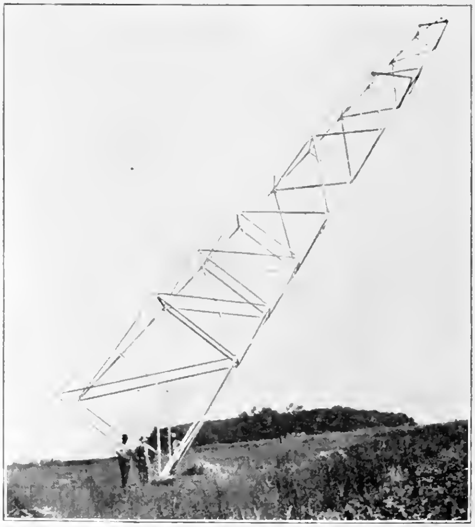
In hard ground foundation bolts are put down in the rock and cemented in, and in soft ground other foundation means are used, which will be described later. The towers and methods of erection, however, are the same. In some places near the power house the towers were erected by being built up in place on account of its being out of the question to erect towers by the ordinary means, on account of the mountainous character of the country.

In addition to the standard towers certain towers were required for the angles in the line. These angle towers were the same as the standard towers in design and differed only in size of the legs and the bracing.

The standard 50 ft. double circuit tower weighs as follows:

Standard tower	4410 lbs.
Foundation	961 lbs.
	5404 lbs.
35 ft. tower 800 lbs. less.	
30 degree angle tower	5321 lbs.
Foundation	775 lbs.
	7099 lbs.
42 degree angle tower	5623 lbs.
Foundation	2055 lbs.
	7678 lbs.
90 degree tower	9140 lbs.
No foundation.	

The 50 ft. tower is 75 ft. 6 in. high, which added to foundations, makes 82 ft. overall. The angle towers, it will be noted, do not weigh very much more



Hoisting Tower Into Position.

than the standard towers. This is because they differ from the standard towers only in having heavier corner posts and heavier diagonal bracing. All angle towers above 10 degrees have concrete deposited in the foundations for additional security.

Insulators: The insulators used consist of a string of 5 similar elements. Each element consists of two porcelain shells, a galvanized malleable iron cap and a central galvanized steel eyebolt. A ½ in. pin and ¼ in. cotter pin complete the element.

The insulators were supplied by the Locke Insulator Manufacturing Company, working under patents owned by Sanderson & Porter.

The porcelain shells which make up the element are tested in the factory by applying 60,000 volts until the pressure has been maintained for two minutes continuously. After testing, porcelain and steel parts are cemented together and tested assembled by applying 90,000 volts between the cap and the "U" bolt until the pressure has been maintained for two minutes continuously. These are the standard proving test applied during manufacture to every insulator.

The insulators were tested out thoroughly at Victor, N. Y., by the late J. D. E. Duncan in 1908 with the following results:

One insulator with 100,000 volts applied stood 6000 lb. tension and failed at 6500 lb. by the breaking of the outer shell; O. K. electrically. Another stood 7200 lb. before breaking of the shell and finally failed by pulling out of the U bolt, the load falling to 5800 lb. during this part of the test. Some units have stood 8000 lb. maximum and all tested stood at least 5500 lbs without distress.

At Schenectady on January 20, 1909, four elements in series were subjected to a spray from above and the current measured by a voltmeter in series with the following results:

200,000 volts	.004 to .005 amperes
224,000 volts	.011
215,000 volts	.012

Three elements in series with a heavy spray which gave a precipitation of 1½ in. in 5 minutes measured by a rain gauge showed a current varying from .5 miliamperes to 9 miliamperes, while the applied voltage was raised from 100,000 volts to 162,000 volts. With additional sprays, so that there were two from above and one from below, the current reached 12 miliamperes and the voltage dropped to 40,000 volts.

On the line the insulators are hung from a trunnion bolted to the end of the tower crossarm and support the copper conductor by a clamp 8 in. long. The trunnion on the end of the arm supports a short steel piece which fits between the jaws of the cap. The ½ in. steel pin of the insulator completes the joint, allowing swing in any direction. The clamp for holding the wire consists of three parts, the clamp proper, the clamp cap and the eyebolt. There are four bolts for holding the clamp together and securing the conductor. The eyebolt is used for the purpose of allowing complete flexibility. A copper sleeve 2/100 in. thick is bent over the copper cable to protect it from any roughness of the clamp, and also to avoid the possibility of localization of the stresses on any strand of the copper conductor.

The same insulators are used for dead ending as are used for supporting the cables. The line is dead ended on the angle towers and in places on straight line towers. The insulators in this case lie in a horizontal position and are found to operate as well in this position as in the vertical position. A strain clamp is used to hold the cable. This consists of two pieces held together with 6¾ in. bolts. The cable lies in a groove in the clamp and is protected from injury by one of the copper sleeves.

The copper conductor is a strand of six wires around a hemp core. The wire is medium hard drawn and was furnished by the American Wire & Steel Company. The area of the copper is the same as a 2/0 wire and the outside diameter of the strand is ½ in. Joints are made by twisting in the same manner as with a McIntyre sleeve. The joint differs from a McIntyre sleeve joint only in being made with a flattened copper tube, large enough to take the two conductors, instead of with a sleeve consisting of twin tubes brazed together. A hemp core was used for two reasons, first mechanical, to allow sufficient flexibility so that all the wires in the strand could accommodate themselves to the load and second to get a larger diameter to reduce to a certain extent the energy loss between conductors (Corona effect, etc.)

Foundations: The steel foundations previously described are satisfactory as long as the ground is of such a character as will permit their use.

As soon as the swampy shores of the bay were reached, it became necessary to use piles to get the necessary bearing to support the weight and also to provide against uplift. To protect the piles above the water line and provide security against marine borers, and at the same time make a pemanent and substantial job, a concrete cap was installed.

Three classes of foundations were designed.

First, consisting of one pile at each corner for a 50 ft. tower. Second, consisting of two piles at each corner for a 112½ ft. tower and third, consisting of three piles per corner for 137½ ft. tower. A fifty foot tower supports the lower conductor 50 ft. above the ground and is 75½ ft. to the apex, the apexes of the 112½ and the 137½ ft. towers are similarly 25½ ft. higher than the lower conductor.

The standard foundation consists of one pile driven at each corner, the earth dug out after driving, the pile sawed off at mean low water line. Two 1¼ in. anchor bolts, 6 ft. 6 in. long are attached to the pile with [illegible] in. lag screws and the pile and bolts covered with a cap of concrete. There are four ⅞ in. reinforcing bars in the corners of the concrete block thus formed and 5 [illegible] in. bars in the form of hoops. The block is 3 x 3 ft. at the bottom and 18 in. x 18 in. at the top and 6 ft. long surrounding 2½ ft. of the end of the pile. The tower is later installed on the foundations. A special clamp bolted to the tower legs provides for the attachment to the anchor bolts.

The other foundations are constructed similarly. The concrete cap is of course larger to surround the additional piles. The concrete caps covering the groups of two piles are 3 x 5 ft. on the bottom. The piles are driven so as to all lie in the diagonal of the tower.

It was required for the 50 ft. towers that one pile be driven at each corner unless the penetration of the last blows of a 2800 lb. hammer falling 8 feet, shall be greater than one inch, in which event an additional pile shall be driven on the diagonal line of the base of the tower and outside the first pile and 30 in. center to

center. The piles required ran from 25 to 70 ft. and usually averaged in the neighborhood of 35 ft. The work was done with a pile driver mounted on skids and movements were made in the usual manner, as long a cable as possible being carried forward for this moving.

PRESERVATION OF POWER TRANSMISSION POLES.[1]

BY W. R. WHEATON.[2]

The increasing cost of power transmission poles in recent years and the high maintenance charges have turned the attention of power companies to some process to increase the life of the poles and to cut down the maintenance charges. The first cost of the poles has nearly doubled in the past six years, and these two factors have been largely responsible for the interest shown by operating power companies in pole preservation.

In March, 1908, the San Joaquin Light & Power Corporation set a line of Western yellow pine (Pinus ponderosa) poles. The line is about 30 miles long and contains approximately 600 poles. These poles were cut in the Sierras above Fresno at an elevation of about 4000 ft., and were thoroughly seasoned before treatment. Some of the poles received a brush treatment with carbolineum and with creosote, and the rest were treated in an open tank with creosote, zinc chloride and crude oil. The butt only was treated. Western yellow pine is very susceptible to a preservative treatment. Some of the butts were thoroughly penetrated with creosote and with zinc chloride, the average penetration (at the ground line) being 3 in. The penetration with crude oil averaged about 1½ in. The crude oil used was a heavy oil of asphaltum base supplied from the Kern River fields. In order to get a comparative life of the wood treated and untreated, stubs of untreated timber were set along the line about a mile apart. The writer inspected this line in June, 1910, at which time it had been set for twenty-seven months. The untreated stubs set along the line were completely rotten. Of the poles brush-treated with carbolineum and creosote the conditions were about the same, a large percentage of each showing signs of decay; 27 per cent of the poles that had a brush treatment with creosote showed signs of decay, and 29 per cent of the poles that had brush treatment with carbolineum showed decay, while 45 per cent of the poles treated with crude oil were slightly attacked by decay. Of the poles treated with zinc chloride, 28 per cent showed attack by decay. The poles treated with creosote in the open tank (over 50 per cent of the entire line were treated in this way) were all perfectly sound and showed absolutely no signs of decay.

In August, 1911, two of the poles in this line which had received a brush coating of creosote fell over, owing to decay at the butt. During August and September, 1911, the line was gone over and all of the poles which had had a brush treatment of crosote or carbolineum were so badly decayed that they were strapped to a creosoted cedar stub.

The above results speak for themselves. The value of the experiment is apparent and is enhanced by the fact that the timber used will entirely decay, without treatment, in a year.

The San Joaquin Light and Power Corporation is now treating Western red cedar poles at the butts only by the open-tank process. There is no necessity for treating the top, since the top is not subject to decay. With this process the outer ring of sap wood on the cedar poles is filled with creosote, and if the timber is thoroughly seasoned before treatment there is little difficulty in accomplishing this. The penetration varies from ½ in. to 1 in. with an absorption of from 7 lb. to 9 lb. per cubic foot. As for the efficiency of the treatment, treated and untreated cedar poles have been set for four years. The creosoted poles are still perfectly sound, while the poles set untreated have decayed through the sap wood and into the heart.

The question has been asked why zinc chloride, copper sulphate or some preservative other than creosote has not been used to cut down the treatment charges. It was found that several poles treated with chloride of zinc were, after the installation of irrigation systems, in the middle of irrigated fields. The zinc was washed out of them, and the poles had to be replaced after a service of two years. The saving in the cost of treatment by the use of a metallic salt would not mean a saving in the end if many such replacements took place. A 50-ft. creosoted pole placed in the line means an investment of about $25. The use of chloride of zinc would cut this cost to about $24.25, and the saving is too small to be considered against the possibility of the loss of the preservative by leeching out after one or two years.

[1] Abstract of a paper read at the annual meeting of the Wood Preservers' Association, Chicago, Ill., Jan. 16-18, 1912.

[2] Timber engineer, San Joaquin Light & Power Company.

NEW INCANDESCENT LAMPS RECENTLY STANDARDIZED.

The year 1911 marks the advent of the drawn wire filament Mazda lamp. This development, the most important in several years, has opened up new possibilities, both in the manufacture and use of high efficiency lamps. Several new sizes of lamps have been added to the standard lines. Regular Mazda lamps for 100-130 volts are now to be had in the 15 and 20-watt sizes in straight sided bulbs, and 15-watt sizes in 2 5/6 in. round bulbs. For voltages between 200 and 260 a 25-watt regular Mazda lamp is now available.

A complete line of Gem and Mazda lamps for street railway service has just been brought out. This includes 35 and 54 watt Gem lamps for burning five in series on 500 to 650 volts. For gauge light service Mazda lamps of the sign type are now made in 2½, 3½ and 5 watt sizes, so selected for current as to operate in series with regular car lamps. The use of regular Mazda lamps in street cars has been proven entirely practicable by numerous service tests under various conditions. Most of the above lamps are derived from regular multiple lamps by operating them at reduced efficiency and power consumption.

To the train lighting list has been added a 10-watt Mazda lamp which has already been used to a large extent as a berth lamp. Among the regular Gem lamps is now listed the 30-watt size in a 2½-inch bulb. These will supply the demand for small incandescent lamps of about 8 or 10 c.p. or replace the similar carbon lamp.

WATER CONSUMPTION FROM INDICATOR CARD.[1]

BY ROBERT SIBLEY

To obtain the actual water consumption used in an engine cylinder is a performance of utmost importance in the practice of steam engineering. There are many ways of computing the water consumption with a more or less degree of accuracy. A rough and ready method is to observe the pressure at which the steam enters the cylinder, in other words observe the boiler pressure and measure the point of cut-off of the steam in the cylinder. By reference to steam tables we can find at once the weight of one cu. ft. of steam at the particular pressure under which the cylinder is operating. Now by computing the volume of steam entering the cylinder up to the point of cut-off and then multiplying this volume in cu. ft. by the weight of each cu. ft. of steam, which constant we have already taken from the steam tables, we can arrive at an approximate value for the steam consumption per stroke. If next we multiply by the number of strokes taking place per hour we are at once enabled to compute the entire steam consumption per hour in the operation of our engine.

In a word if N represents the number of strokes per minute (in a double acting engine this is twice the number of revolutions per minute), l is the distance in feet from the beginning of the stroke at which the point of cut-off takes place, a the area of the cylinder bore in sq. ft. and w the weight of one cu. ft. of steam at boiler pressure, we have that the total water consumption per hour is

$$W = 60\, w\, a\, l\, N \qquad (1)$$

As an example let us take the same engine used in computing the horsepower in the last lecture. It will be recalled that this engine operates at 120 r.p.m., its cylinder bore is 18 in., the point of cut off 6 in. from beginning of the stroke, and the boiler pressure 80 lb. gauge.

Since 80 lb. gauge is 94.7 lb. abs. I look in my steam tables under 94.7 and find w = 0.2147. Hence we have

$$W = 60\, w\, a\, l\, N$$

$$= 60 \times .2147 \times (.7854 \times 1.5^2) \times \frac{6}{12} \times (2 \times 120) = 4175 \text{ lb.}$$

It is interesting to note in passing that our engine in question for its particular type has a reasonable economy, for since we have formerly found it capable of developing 175.8 h.p., the water consumption per horsepower is, then $\frac{4175}{175.8} = 23.75$ lb.

The Buckeye Engine Company has prepared in their catalog an interesting table on the basis of pressures that result in practice with a constant boiler-pressure of 80 lb. and different points of cut-off with Buckeye engines and others of similar clearance.

It will be seen that while the best indicated economy is when the cut-off is about at 0.15 or 0.20 of the stroke, giving about 30 lb. mean effective pressure and a terminal 3 or 4 lb. above atmosphere, when we come to add the percentages due to a constant amount of unindicated loss, as per sixth column, above, the most economical point of cut-off is found

Cut-off Part of Stroke.	Mean Effective Pressure, lbs. per sq. in.	Total Terminal Pressure, lbs. per sq. in.	Indicated Rate, lbs. Water per I.H.P. per hour.	Assumed. Act'l Rate	Assumed. % Loss.	Product of Cols. 1 and 6.
0.10	18	11	20	32	58	5.8
0.15	27	15	19	27	41	6.15
0.20	35	20	19	25	31.5	6.3
0.25	42	25	20	25	25	6.25
0.30	48	30	20	24	21.8	6.54
0.35	53	35	21	25	19	6.65
0.40	57	38	22	26	16.7	6.68
0.45	61	43	23	27	15	6.75
0.50	64	48	24	27	13.6	6.8

Theoretical Compared With Actual Water-Consumption.

to be about 0.30 of the stroke, giving 48 lb. mean effective pressure, and 30 lb. terminal pressure. This showing agrees substantially with modern experience under automatic cut-off regulation.

As the hot steam enters the cylinder which has just been cooled by the outgoing exhaust steam a portion of this incoming steam is condensed into water, consequently we are unable to get an exact valuation for this steam by the method just outlined. After the steam has been cut off from entering the cylinder we have previously found that it expands, following very closely the isothermal law of expansion. Toward the end of the stroke the pressure, having been reduced by the expansion of the steam permits the water, which condensed at the earlier part of the stroke, to re-evaporate into steam, hence about 2/3 down along the line of expansion we will arrive at a point which in all probability represents the condition we are looking for, namely, uniformity.

Looking now at Fig. 1, let us follow with our eye down along the expansion line from the point B to a point P which is about the proper place on the ex-

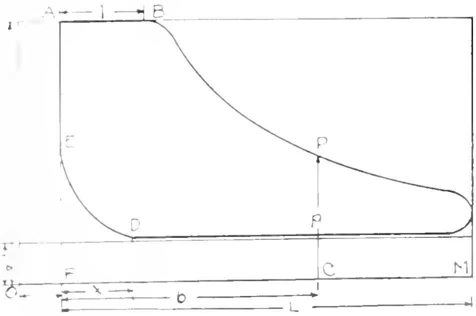


Fig. 1.

pansion line from which to make our water consumption computation. Having previously drawn the absolute zero line O M on the indicator card, at the point P on the curve we fall a perpendicular P C to the line O M. Since our indicator card is drawn to a definite scale we can read off our scale the pressure P C. Let us call this pressure p. We next scale off the distance F C in proportion to the total stroke F M and we have at once the distance out from the beginning of our stroke at which our point P is located. It is

[1] This paper comprises the Nineteenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

evident now if we multiply the volume of the steam enclosed at this point by the weight in lb. per cu. ft. we can determine the steam supply per stroke.

If a is the area of the cylinder bore in sq. ft., b is the distance in feet that the point P is located from the beginning of the stroke and c is the clearance in feet, then the cubical contents of the entrapped steam is $a(b + c)$ cu. ft. If now this steam weighs w lb. per cu. ft., the total weight of steam is $wa(b + c)$.

All of this steam however is not entirely utilized per stroke for a certain portion of it is still in the cylinder at the point of compression. If x is the distance in feet that the point of compression is located from the beginning of the forward stroke, c is the clearance in ft. and P_b the back pressure in the cylinder and w_1 the weight of a cu. ft. of the steam, then $w_1 a(x + c)$ is the weight of steam cooped up in the cylinder at the end of the stroke.

In order now to compute the net amount of steam utilized in each stroke in the cylinder we should take the difference between these two quantities or

Net steam consumption per stroke $= wa(c + b) - w_1 a(c + x)$.

Since there are N strokes per minute or 60N strokes per hour the total consumption of steam per hour in pounds is

$$W = 60\,N\,[wa(c + b) - w_1 a(c + x)]$$
$$= 60\,N\,a\,[w(c + b) - w_1(c + x)]$$

Returning again to our former example, let us compute the water consumption per horsepower per hour by this more exact method. Fig. 1 represents an indicator card for this engine which in addition to the constants above listed, it will be recalled, has a clearance of 1/10 stroke, the stroke being 24 in. The point of compression takes place 20 in. from the beginning of the return stroke, and the back pressure is 1.3 lb. gauge.

From the card as shown we scale off p and find it to be 45.5 lb. abs., and also b is found to scale 15.04 in. By reference to steam tables w is then found to be 0.1076 lb. per cu. ft. and w_1, corresponding to a pressure of 1.3 + 14.7 or 16 lb. abs. is 0.0404 lb. per cu. ft.

Hence substituting in our formula, we have

$$W = 60\,N\,a\,[w(c + b) - w_1((c + x)]$$
$$= 60 \times (2 \times 120) \times \left(\frac{.7854 \times 18^2}{144}\right) \times$$
$$\left[0.1076\left(\frac{2.4 + 15.04}{12}\right) - 0.0404\left(\frac{2.4 + 4}{12}\right)\right]$$
$$= 26960\,[0.1563 - 0.0215]$$
$$= 26960 \times 0.1348 = 3634 \text{ lb. per hour.}$$

Hence water consumption per indicated horsepower per hour is

$$\frac{3634}{175.8} = 20.65 \text{ lb.}$$

In performing a test to determine the water consumption per hour by actual measurement it is often found that leakage occurs in the circulating water system and consequently the test is inaccurate. There are various methods used in practice to check up the results of tests in order to see if any leakage has taken place. In those plants operating by means of a surface condenser, that is, one in which the circulating water and condensing steam do not mingle, a test known as the silver nitrate test is found very satisfactory in order to determine whether leakage has taken place or not.

Years ago the chemist found that if silver nitrate is mixed with water having only a very slight amount of salt in solution a white precipitate is formed. Hence in those plants which utilize sea-water for their circulating water this quantitive test is of much importance. Chemically speaking the reaction which takes place when silver nitrate is poured into water containing salt in solution is

$$Ag\,NO_3 + Na\,Cl = Ag\,Cl + Na\,NO_3$$

If we are able to measure exactly the amount of leakage which has taken place we can then make a proper correction for our total water consumption. To this end engineers have found it practical at times to pass the circulating water through the pipes and maintain the same vacuum in the condenser that is maintained when the engine is in operation. If now the water coming through is carefully weighed, and the test covers a period of three or four hours, a proper determination of the leakage can be made. It is needless to say that any appreciable leakage should be determined and stopped before a test is made. Careful tryouts should be made previous to the running of the test and after its completion, to assure against leakage.

In the case of reciprocating engines operating by a throttling governor, that is one in which the point of cut-off remains constant, we now propose to show that, when the water consumption is plotted as ordinates and the power development as abscissas, a straight line is the result.

We have previously found that the forward pressure in the steam engine is equal to $p_1\left(\frac{1 + \log_e r}{r}\right)$ in which p_1 is the boiler pressure and r the ratio of expansion of steam in the cylinder. If now n is the number of revolutions per minute and V the cubical contents of the steam cylinder, the total volume of steam consumed per hour is evidently 120 (nV). Let us assume that the expansion in the cylinder is isothermal. Under these conditions we have previously seen that $p_1 v_1 = k$, in which v_1 is the initial volume of the steam and k is a constant. Hence if we let W equal the weight of steam consumed per hour we now see that

$$W = \frac{120\,(nV)}{v_1} = \frac{120\,(nV\,p_1)}{k}$$ when considering the throttling governor, and since the point of cut-off is a constant, all of the factors in the above expression are constant except p_1. Hence if z is a constant we have $W = zp_1$.

Since the forward pressure is equal to $p_1\left(\frac{1 + \log_e r}{r}\right)$ it is then evident that $p_f = cp_1$ or $W = \frac{z\,p_f}{c}$. We have previously found that the mean effective pressure acting upon the cylinder head is equal to the forward pressure less the back pressure,

or $M.E.P. = (p_f - p^b) : .\cdot.\ W = \frac{c}{z}(M.E.P. + p^b)$.

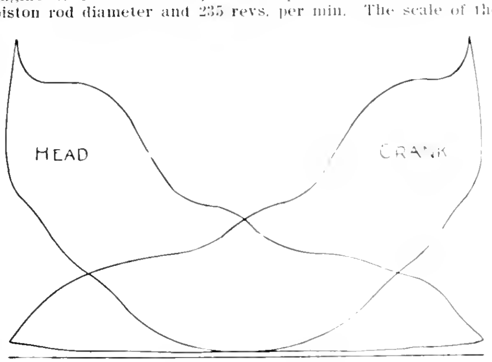
In the study of analytic geometry we have seen that a straight line is represented by the formula $y = mx + b$. Comparing this equation with the one above we see at a glance that the water consumption is represented by a straight line when plotted to scale. It will be remembered, however, that we have assumed isothermal expansion for the steam engine cylinder. As a matter of fact, to be absolutely accurate this line inclines slightly upward when plotted.

Hence when a test for water consumption has been made on the steam engine, if the same does not plot very approximately into a straight line we know at a glance that some error must have been made in the test and most frequently the error is that of leakage from the circulating water.

Although the above is only true in the case of a throttling steam engine, in the case of a turbine whether is be governed by throttling or otherwise this curve of water consumption is a straight line and is known as the Willan's law.

Thermotwisters.

1. The indicator card given below is that of a simple engine of 12 inch stroke, 12 inch piston diameter, 1½ inch piston rod diameter and 235 revs. per min. The scale of the



Problem in Water Measurement

highest pressure point shown on the card is 80 lb. gauge. What is the indicated water consnmption per hour, without making allowance for piston rod diameter.

2. Compute the indicated water consumption per hour, making full allowance for piston rod displacement

HYDROELECTRIC ENTERPRISE IN PERU.

Arequipa is the second city in size and in commercial importance in Peru. It has 40,000 population, and is in the interior four hours by rail from the busy port of Mollendo. The hydroelectric power station of the Sociedad Electrica de Arequipa (Ltda.) has four Voith turbines coupled direct to Siemens-Schuckert Werke generators. The company is capitalized at $300,000, on which 10 per cent annual dividends have been paid from the beginning. Gross earnings have climbed from $2500 a month in 1905 to $7300 a month in 1911, while operating expenses since the present plant was installed have slowly but steadily been reduced.

WHEN DOES IT PAY TO DEVELOP WATER POWER?[1]

BY J. R. THOMPSON.

In a diversified country, such as the Northwest, to give any fast and set rule for a subject like this would be impossible. The purpose of this paper is to deal solely with the power house end of electric power generation, and to show one of the prime reasons why many developments have not been made and why in many cases it has rendered the installation of a steam generating plant imperative. While these developments of course, are dependent upon the market for the gross income, their annual increase to some extent may be influenceed by expectations. "Expectations" I shall take up later, but for the present they shall be considered as parts of the proposed assets which affect the gross income and are to be carefully considered and in most cases seriously avoided.

In the States of Oregon, Washington and Idaho there are innumerable hydraulic developments, which total several million horsepower, the exact amount I do not profess to know with any degree of accuracy. Numerous estimates have been made of from 3 to 5 million horsepower and by this is meant power that can be developed for each hour in each day and every day in the year. In the same territory there are generated by water power and steam plants together, approximately 250,000 kw. at the present time. One-half to two-thirds of this is generated by water power, the balance by steam. Also in the distributing territory, which may be classified as Portland, Seattle and Tacoma, and Spokane, two-thirds of this total is either generated or distributed in the cities or the adjacent territory.

The present yearly increase in demand for electric power is between 20 and 30 per cent in all vigorous and growing sections of the Northwest. This means a required development yearly of from 50,000 to 80,000 kw. to supply this growing demand for electric power and while it constitutes but a small percentage of the total of possible developments, it represents a very heavy growth and points to great possibilities for future hydroelectric development.

The type of developments vary throughout the wide range of hydraulic possibilities, from very low heads to extremely high ones, that is from 10 to 1500 foot hydraulic heads. The topographical, climatic and hydraulic conditions where these developments are possible, vary as greatly as their hydraulic heads. So that which may hold good in one place, 50 or 100 miles away would not apply at all. The run-off of various streams, due to diversified topographical and climatic conditions, has a serious effect on the amount or sale of power by reason of its effect on the amount of settlement of the country and the consequent demand for electric power.

The cost of power plant development, dependent on these various conditions which I have enumerated, has a very wide variation from perhaps $50.00 per kw. to $250 per kw. of installed capacity of plants. This is also governed to some extent by the size of many of the proposed developments, the range of which may be said to vary from 100 kw. to 40,000 kw.

[1] Paper presented before Portland Section A. I. E. E., Jan. 16, 1912.

In connection with the market or gross income of the plant, the cost of operation is a matter of utmost importance. The fixed charges on most plants would be something like this: Interest 6 per cent, depreciation 7 per cent, taxes 2 per cent, total 15 per cent on the investment. To this must be added the administration cost of $1.00 to $3.00 per kw. and the labor cost of $1.50 to $12.00 per kw. of installed capacity. This variation in the labor cost may seem large, but is altogether dependent on the size of the plant as well as conditions of operation. I have known some small plants, where the power house labor charge was equal to the latter figure, or $12 per annum per kw., that were profitable and paying dividends. The fixed and operating charges I do not intend to carry beyond the point of delivery of the power to the substations, as from here the unit cost has a greater variation with each center of distribution and the method thereof. In addition to the investment and labor charges, there is an efficiency charge dependent on the methods of distribution, the conversion of the generated power to other kinds of current and the losses in distribution.

It is not my intention to discuss rates in this paper, as there are a multitude of different ones, but the question of interest to the investor is, what will the gross income be for the power house, both in the sum total per kw. of actual peak load and in the ultimate generating capacity of the power plant. This is foremost in the mind of the engineer in the investigation of proposed hydraulic development, and is the fact to be determined before any development can be started. Suppose we have arrived at the point with a development where the question of flow, dam, intake, flume and pressure pipes, power house and transmission are all behind us, and the question of market, annual growth and expectations are the matters to be determined. As a matter of argument I have taken the cost of development at $100 per kw. of power house installation to include transmission to the substations. In most developments, of this $100.00, $60.00 to $70.00 per kw. must be expended no matter what per cent of the possible power is generated. In contrast to this is the steam plant which can be and usually is built in sections, and even if the entire power house for the ultimate capacity of the plant is built, an expenditure of $20 per kw. of the ultimate capacity of the plant would be excessive. This would also include the real estate investment for the plant. As a matter of fact, steam plants are built in sections, and the capital invested is only expended as an increase in plant is needed. I do not wish to be considered as an advocate for steam development by this, but what I wish to show is that in many hydraulic developments, until a market is found for a large per cent of the power that can be generated, there is liable to be a large fixed operating charge against that for which the plant has a market, and which in many cases the gross income from the market is not capable of meeting. As an example in a development of say 10,000 kw. having a market for 2500 kw., the total installation expense for this plant would be one million dollars, and for the 2500 kw. at least $700,000 would have to be expended, or $280.00 per kw. for which the plant has a market. The fixed charge of this would amount to $42 per annum per kw., and the administration and labor charge at least $4 per kw. per annum, or a total of $46.00 per kw. per annum. If on the other hand there is a market for the total 10,000 kw. the fixed charge would become $15.00 per kw. per annum, and the administration and labor charge would be $2.50 per annum per kw. or a total of $17.50 per kw. per annum.

It is clearly seen by these figures that the gross income from your market must be large enough to cover the first case in order to render it profitable to develop the power, and when the full capacity of the plant is reached, the investment should be a very profitable one. I do not wish this cost of generation to be considered as applicable to any power plant, but it is a general average case. The above case cited is one of the most general which the engineer meets in his investigation of hydraulic development in the Northwest.

I have spoken of the market annual increase and expectations. Perhaps in this I have coined a new word, or at least a new use for one. Usually in many of the proposed developments which the engineer has to investigate, the market is short and after the annual growth is undergone, the promoters bring forth what I term "expectations." Nearly all of these some day will be tangible assets in the gross income of power companies, and they include such things as furnishing power for railroads, from transcontinental lines to branch systems; irrigation and drainage systems; heating; logging; the manufacture of iron and steel; pulp mills; the manufacture of ice; and many other applications, which could not be considered immediately unless the expectations were to be financed by the same people who develop the power and thereby find their own market.

The consolidation of many small plants will advance and aid in the development of hydroelectric power thereby making it possible to show economy by the operation of single power stations. The annual increase in the power demand of such consolidations will be in many cases met by the entire output of some one of the power developments. In other cases it will be possible to carry a slight loss for a year or two until a demand for the full power capacity is secured.

INTERURBAN ELECTRIC RAILWAY MILEAGE IN CALIFORNIA.

Figures compiled in the offices of Chief Engineer Thompson of the State Railway Commission show the mileage of the interurban railways in California now to be 1732.99. Electric roads operating only within the limits of various municipalities are not included in the figures. Of the 1732.99 miles of interurban roads 1082.95 are on the main line; 465.01, second track, and 175.03, sidings. The 1910 total was 1432.94, 1911 thus having gained 250.05 miles. The largest roads and their main-line mileage are as follows: Central California, 55.29; East Shore and Suburban, 17.15; Northern Electric, 108.81; Oakland and Antioch, 14.50; Oakland Traction, 101.47; Pacific Electric, 106.50; Pacific Electric, leased, 450.89; Petaluma and Santa Rosa, 31.60; Peninsula Railway, 41.85; San Francisco and Napa Valley, 33.84.

AN IMPORTANT LAW.

Numerous inquiries have come into the editorial department of the Journal of late relative to the interpretation of Chapter 499 of the statutes of California for 1911. This enactment was approved April 22, 1911, and is an act regulating the placing, erection, use and maintenance of electric poles, wires, cables and appliances, and providing the punishment for the violation thereof.

Section 1. No commission, officer, agent or employee of the State of California, or of any city and county or city or county or other political subdivision thereof, and no other person, firm, or corporation shall

(a) Run, place, erect or maintain any wire or cable used to conduct or carry electricity, on any pole, or any crossarm, bracket or other appliance attached to such pole, within a distance of thirteen (13) inches from the center line of said pole; provided, that the foregoing provisions of this paragraph (a) shall be held not to apply to telephone, telegraph or other "signal" wires or cables which are attached to a pole to which is attached no wire or cable other than telephone, telegraph or other "signal" wire or cable, except within the corporate limits of any city or town which shall have been incorporated as a municipality, nor shall the foregoing provisions be held to apply to such wires or cables in cases where the same are run from underground and placed vertically on poles, nor to "bridle" or "jumper" wires on any pole which are attached to telephone, telegraph or other "signal" wires on the same pole, nor to any "aerial" cable, as between such cable and any pole on which it originates or terminates, nor to wires run from "lead" wires to arc lamps or to transformers placed upon poles, nor to any wire or cable where the same is attached to the top of a pole, as between it and the said pole, nor to any "aerial" cable containing telephone, telegraph or other "signal" wires where the same is attached to a pole on which no other wires or cables than wires continuing from said cable are maintained, provided, that electric light or power wires or cables are in no case maintained on the same side of the street or highway on which said "aerial" cable is placed.

(b) Run, place, erect or maintain in the vicinity of any pole (and unattached thereto) within the distance of thirteen (13) inches from the center line of said pole, any wire or cable used to conduct or carry electricity, or place, erect or maintain any pole (to which is attached any wire or cable used to conduct or carry electricity) within the distance of thirteen (13) inches (measured from the center of such pole) from any wire or cable used to conduct or carry electricity; provided, that as between any wire or cable and any pole, as in this paragraph (b) named, only the wire, cable or pole last in point of time run, placed or erected, shall be held to be run, placed, erected or maintained in violation of the provisions of this paragraph; and further provided, that the provisions of this paragraph (b) shall not be held to apply to telephone, telegraph or other "signal" wires or cables on poles to which are attached no other wires, as between such wires and poles to which are attached no other wires or cables than telephone, telegraph or other "signal" wires, provided such wires, cables and poles are not within the corporate limits of any town or city which shall have been incorporated as a municipality.

(c) Run, place, erect or maintain, above ground, within the distance of four (4) feet from any wire or cable conducting or carrying less than six hundred volts of electricity, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, or run, place, erect or maintain within the distance of four (4) feet from any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity any wire or cable conducting or carrying less than six hundred volts of electricity; provided, that the foregoing provisions of this paragraph (c) shall be held not to apply to any wires or cables attached to a transformer, within a distance of four (4) feet, (measured along the line of said wire or cable) from the point where such wire or cable is attached to such transformer, nor to wires or cables within buildings or other structures, nor to wires or cables where the same are run from underground and placed vertically on poles, nor to any "lead" wires or cables between the point where the same are made to leave any pole for the purpose of entering any building or other structure, and the point at which they are made to enter such building or structure, and provided further, that as between any two wires or cables, or any wire or any cable run, placed, erected or maintained in violation of the provisions of this paragraph (c), only the wire or cable last in point of time run, placed or erected shall be held to be run, placed, erected or maintained thus in violation of said provision, and further provided, that where no more than one crossarm is maintained on a pole, all the wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all the wires or cables conducting or carrying less than six hundred volts of electricity shall be placed on the crossarm on the other side of the pole, and further provided, that the space between any wire or cable carrying or conducting at any one time more than six hundred volts of electricity and any wire or cable carrying less than said voltage shall be at least thirty-six (36) inches clear measurement in a horizontal line; and further provided, that where two or more systems for the distribution of electric light or power occupy the same poles with wires or cables, all wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarms on one side of the pole, and all wires or cables conducting or carrying less than said voltage shall in such case be placed on the crossarms on the other side of the pole, and further provided, that the space between any wire or cable conducting or carrying at ony one time more than six hundred volts of electricity and any wire or cable conducting or carrying less than said voltage shall be at least thirty-six (36) inches in measurement in a horizontal line, and further provided that in such construction all crossarms shall be at least thirty-six (36) inches apart in a vertical line.

(d) Run, place, erect or maintain, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, without causing each crossarm, or such other appliance as may be used in lieu thereof, to which such wire or cable is attached to be kept at all times painted a bright yellow color; or, on such crossarm, or other appliance used in lieu thereof, shall be placed enamelled iron signs, providing, in white letters on a green background, the words "High voltage," and these letters shall be not less than three (3) inches in height, said signs shall be securely fastened on the face and back of each crossarm. The provisions of this paragraph (d) shall not be held to apply to crossarms to which are attached wires or cables carrying or conducting more than ten thousand volts of electricity, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(e) Run, place, erect or maintain any "guy" wire or "guy" cable attached to any pole or appliance to which is attached any wire or cable used to conduct or carry electricity, without causing said "guy" wire or "guy" cable to be effectively [illegible]lated at all times at a distance of not less than four (4) [illegible] nor more than eight (8) feet (measured along the line [illegible] said wire or cable) from the upper end thereof, and at a point not less than eight (8) feet vertically above the ground [illegible] the lower end thereof; and further provided, that wher[illegible] two or more "guy" wires or "guy" cables are attached [illegible] there shall be at least one foot, vertical space, between the points of attachment, and further provided that no [illegible] shall be required at the lower end of a "guy" wire or "guy" cable where the same is attached to a grounded anchor; [illegible] provisions of this paragraph (e) shall be held to

apply to "guy" wires or "guy" cables attached to poles carrying no wire or cable other than telephone, telegraph or other "signal" wire or cable, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(f) Run, place, erect or maintain, vertically on any pole, any wire or cable used to conduct or carry electricity, without causing such wire or cable to be at all times wholly encased in casing equal in durability and insulating efficiency to a wooded casing not less than one and one-half inches thick. The provisions of this paragraph (f) shall not be held to apply to vertical telephone, telegraph or other "signal" wires or cables on poles where no other than such wires or cables are maintained, and which are outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(g) Place, erect or maintain on any pole, or on any crossarm or other appliance on said pole, which carries or upon which is placed an electric arc lamp, any transformer for transforming electric currents.

(h) Run, place, erect or maintain any wire or cable carrying more than fifteen thousand volts of electricity across any wire or cable carrying less than said voltage or across any public highway, except on poles of such height and so placed at each crossing that under no circumstances can said wire or cable of said voltage higher than fifteen thousand volts in case of breakage thereof or otherwise, come in contact with any wire or cable of less than said voltage, or fall within a distance of ten (10) feet from the surface of any public highway; or in lieu thereof double strength construction may be installed, in which case the wires carrying a voltage higher than fifteen thousand volts shall, between the points of crossing, be of a cross-section area equal to at least twice that used in the line outside of such crossing, except where the conductor used is equal to four nought (0000) Brown and Sharpe gauge or greater, in which case the wires or cables will be considered as complying with the law.

(i) Run, place, erect or maintain any suspension wire to which is attached any "aerial" cable of "75 pair number nineteen Brown and Sharpe gauge" or over, or of "100 pair number twenty-two Brown and Sharpe gauge" or over, suspended from a crossarm, (or from any other structure or appliance from which said suspension wire is hung) by a single bolt and clamp without at the same time attaching said suspension wire to said crossarm, structure or appliance by an additional "safety" bolt and clamp (or other "safety" appliance for thus attaching said suspension wire) of tensile strength equal to the first herein said bolt and clamp.

Sec. 2. None of the provisions of the preceding section shall be held to apply to "direct current" electric wires or cables having the same polarity, nor to "signal" wires when no more than two (2) of such "signal" wires are attached to any one pole, provided, that none of such "direct current" or "signal" wires shall in any case be run, placed, erected or maintained within the distance of thirteen (13) inches from the center line of any pole (other than the pole or poles on which said wires or cables are carried) carrying electric wires or cables; and provided further, that as between any two wires, or cables, or any wire or cable run, placed, erected or maintained in violation of the provisions of this section 2 only the wire or cable last in point of time run, placed, erected or maintained shall be held to be run, placed, erected or maintained thus in violation of said provisions.

Sec. 3. No commission, officer, agent or employee of the State of California or of any city and county or city or county or other political subdivision thereof, and no other person, [illegible] corporation shall run, place, erect or maintain any [illegible] attached to any wire or cable used to conduct or [illegible] electricity, without causing said "span" wire to be at [illegible] effectively insulated between the outer point at which it is in any case fastened to the pole or other structure by which it is hung or supported, and at the point at which it is in any case thus attached, provided, that such insulation shall not in any case be placed less than two (2) feet nor more than four (4) feet from said point at which said "span" wire is so attached, and that when in any case, such "span" wire is attached along its length to any two (2) such wires or cables, conducting or carrying electricity and extending parallel to each other, not more than ten (10) feet apart, such insulation shall not be required therein at any point between such parallel wires or cables; none of the provisions of this section (3) shall be held to apply where "feeder" wires are used in place of "span" wires.

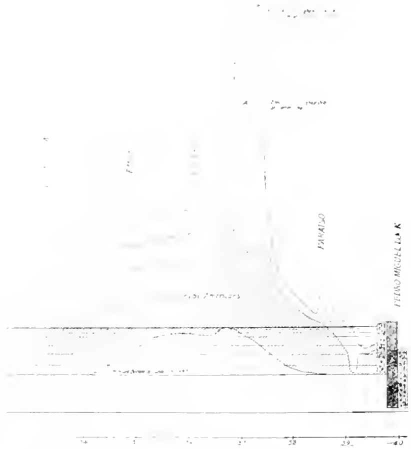
Sec. 4. Any violation of any provision of this act shall be deemed to be a misdemeanor, and shall be punishable upon conviction by a fine of not exceeding five hundred dollars ($500.00) or by imprisonment in a county jail not exceeding six (6) months or by both such fine and imprisonment.

Sec. 5. All acts or parts of acts which are in conflict with the, or with any of the provisions of this, act, are hereby repealed.

Sec. 6. This act shall take effect six months from the date of its passage in so far as it relates to new work, and a period of five years shall be allowed in which to reconstruct all existing work and construction to comply with the provisions of this act.

CULEBRA CUT—EXCAVATIONS IN DECEMBER AND FOR 1911 GREATEST OF RECORD.

The excavation in Culebra Cut in December 1,351,082 cubic yards, was the greatest accomplished in any December of the eight since the American canal work was begun. It brought the total for the year up to 16,596,891 cubic yards, and this is the greatest that



[illegible] January 1, 1912 [illegible] 82 per cent completed

has been accomplished in any year. The record for previous Decembers, and for previous years, compared with December, 1911, and the year 1911, follows:

Excavation in Culebra Cut, December, 1904, to 1911.

December.	Cubic Yards.
1904	42,935
1905	70,630
1906	307,689
1907	1,025,185
1908	1,210,046
1909	1,152,022
1910	1,211,400
1911	1,351,082

Excavation in Culebra Cut, years, 1904 to 1911.

Year.	Cubic Yards.
1904	243,472
1905	914,254
1906	2,702,991
1907	9,177,130
1908	13,912,153
1909	14,557,034
1910	15,398,599
1911	16,596,891
Total	73,502,824

There remain to be excavated 15,911,181 cubic yards, and the work in this part of the Canal is thus 82 per cent completed.

The high excavation is due to the fact that there has been very little rainfall in the territory of Culebra Cut during December, which is ordinarily considered one of the rainy season months.

Since December, 1907, the excavation has fallen below the million-yard-a-month mark only once, and the rate at which it has advanced during the year just closed is shown in the following statement:

Months	Cubic Yards
January	1,356,391
February	1,199,738
March	[illegible]
April	1,411,776
May	[illegible]
June	[illegible]
July	1,337,833
August	[illegible]
September	[illegible]
October	[illegible]
November	[illegible]
December	1,351,082
Total	[illegible]

The work in December was done by 40 steam-shovels.

AMERICAN FOREIGN TRADE INCREASE.

The foreign commerce record of the United States for the calendar year 1912, so far as relates to total imports and exports, shows imports $1,532,931,861, a larger total than in any year except 1910, which showed $1,562,904,151 as the value of imports. The exports of the calendar year 1911 were valued at $2,092,375,141, a larger total than in any preceding year, and considerably larger than the total of $1,923,426,205 shown by 1907, the former high record year in exports. The excess of exports over imports in the calendar year just ended was $559,441,280, a larger excess of exports than in any year since 1908, when the total was 636 million dollars, while that of 1900 was 649 million dollars. The dutiable imports were $738,481,025 in value; those free of duty, $794,450,836, the share entering free of duty being 51.82 per cent. The total commerce, imports and exports combined, was $3,625,305,002, against $3,429,163,055 in 1910, the former high record year in total trade.

AMERICAN GOLD AND SILVER OUTPUT.

The gold-mining industry was generally active in 1911, but early figures indicate that the total production for the United States and Alaska was slightly below that of 1910. The preliminary figures of the Director of the Mint indicate a total domestic gold output of $96,233,528 in 1911, against $96,269,100 in 1910. According to estimates made by the Bureau of Statistics, the imports in 1911 comprised gold valued at $11,150,000 in foreign ore, $29,300,000 in foreign bullion, $5,750,000 in United States coin, and $10,050,000 in foreign coin—a total of $56,250,000. The gold exported in 1911 was valued at $500,000 in domestic ore, $8,050,000 in domestic bullion, $30,000,000 in United States coin, and $2,250,000 in foreign coin—a total of $40,800,000. The excess of imports over exports was about $15,500,000, indicating a marked change from the conditions in 1910, when the excess of imports over exports was $417,696, and also from those in 1909, when the excess of exports was $88,793,855.

The gold imported in 1911 was mainly in the form of ore and bullion, and came chiefly from Mexico, although considerable gold is received from Canada every year, and smaller amounts from the Central and South American countries, and in 1911 a large quantity of gold was imported from Japan. The exports consisted largely of gold coin and went chiefly to Canada, although smaller shipments were also made to France, South America, the West Indies, and Japan.

Owing largely to the prosperity of the gold, copper, and lead mining industries there was an output of silver in 1911 estimated at 57,796,117 fine ounces. This is 2,182,997 ounces more than the average annual output of 55,613,120 ounces of the preceding decade and 658,217 ounces more than the output of 1910.

Preliminary figures compiled by the Director of the Mint indicate a total domestic production of silver of 57,796,117 fine ounces in 1911, valued at $31,787,866. The production in 1910 was 57,137,900 fine ounces, of [illegible] commercial value of $30,854,500.

The average price of silver in 1911 was 53 cents per fine ounce, a decrease of 1 cent from that of 1910.

The estimates made by the Bureau of Statistics place the imports of silver in 1911 at $27,450,000 in foreign ore, $12,850,000 in foreign bullion, $2,150,000 in United States coin, and $1,350,000 in foreign coin—a total of $43,800,000. The exports of silver during the same year were valued at $135,000 in domestic ore, $[illegible] in foreign ore, $59,000,000 in domestic bullion, $4,750,000 in foreign bullion, $100,000 in United States coin, and $600,000 in foreign coin—a total of $[illegible], or $20,850,000 in excess of the value of the imports.

In 1910 the value of the excess of exports over imports of silver was $11,482,805; in 1909 it was $11,[illegible], and in 1908 it was $9,613,541. Previous to 1908 it had not been below $15,000,000 for several years.

The imports of silver in 1911 were, as usual, chiefly [illegible] and came mainly from Mexico and [illegible]; the exports were almost wholly in ore and [illegible], as usual, chiefly to the United [illegible] in smaller amounts to Hongkong and

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

An Important Law

On April 22d last a law appearing as Chapter 499 in the 1911 Statutes of the State of California was approved. This law is an act regulating the placing, erection, use and maintenance of electric poles, wires, cables and appliances, and providing a punishment for the violation thereof. The complete details of this law will appear elsewhere in these columns.

As the provisions of this enactment did not become effective for new work until six months after its passage and as a period of five years is allowed in which to reconstruct all existing work, the contents of the act have thus far been almost wholly without discussion among the public service corporations of the State.

Now that new work is being undertaken in various parts of the Commonwealth of California, much agitation is rife as to its proper interpretation. In fact there is much reason for agitation for the law is grossly inconsistent in its terms. In the first place, under the heading (c), a corporation is forbidden to erect or maintain any cables or wires closer than four feet from center to center and yet toward the end of the same paragraph they are forbidden from placing any wires or cables less than thirty-six inches apart—inconsistency without question.

The provision relative to the placing of warning signs on high tension crossarms seem grossly unfitting and it certainly is deplorable that a committee of men versed in affairs of this nature should not have seriously gotten together to discuss these questions before the passage of the law.

The question of proper protection at the crossing of public highways is one that will certainly under the present provision of the statute bring an enormous burden to the high tension lines now transversing the State, and will cause thousands upon thousands of dollars in expense to meet these provisions. It seems that a much better protection could be secured by less drastic methods.

It is high time now, however, since the law has been passed and is now in force that corporations pay strict attention to its content for infringement is punishable not only by fine but imprisonment.

It would seem most highly profitable for all concerned that a committee representing a number of the corporations engaged in new work and in fact those operating old lines but which will have to be remodelled to meet the new conditions should meet at an early date to discuss the provisions of this act and see if it would not be possible to bring about needed changes and amendments to the law.

Panama Canal and its Coast Influence

Elsewhere in these columns will be found detailed the progress of affairs concerning the Panama Canal. When but mere children, we were held spellbound by the description of the adventures and conquests of the early Spanish soldiers of fortune. The unique civilization of the Aztecs, visited and vanquished by the dauntless Cortez, and the unique and picturesque life of the Incas, similarly visited and vanquished by the invincible Pizarro, have

ever been the fuel to aid the American boy in forming his ideas of constructive imagination. But in the light of the modern trend of events, no one picture could be painted that would show such a story without words as that of Balboa, climbing the heights of the Panama Mountains and for the first time gazing out upon the broad expanse of the great Pacific. The emotions experienced and dreams cherished by this Spanish adventurer were undoubtedly similar to those enjoyed by the world today, for this broad expanse beyond the seas will soon be opened for the first time, offering an opportunity for the building of new empires in the struggle for commercial supremacy.

The whole world is at present in a state of agitation and flurry. The daily Consular Reports teem with plans and dreams of aggrandizement on the part of the nations of the earth in their quivering expectation of what the Panama Canal will bring to them in the readjustment of the world's commerce.

Undoubtedly no truer saying has ever been uttered than that of "Westward, the course of empires takes her sway." The islands of the sea, the long stretches of coast bordering the Pacific, both in the Occident and Orient, daily turn their eyes toward Mecca, but when they awaken, no longer is it the Mecca of the Arabs' dreams but rather the gigantic task now under way in the little neck of land connecting North and South America. The daily papers are filled with the plans now being formed by the great ship owners' companies of the Atlantic, in which they announce that the tide of immigration will no longer pour into New York and other Eastern ports, but, by means of the Panama Canal, thousands of immigrants will be disembarked in the land, which Horace Greeley had in mind when he said "Go west, young man, go west."

Those who have given much study to this question of immigration predict for the coast States an unusually high type of immigrant. The lower forms, comprising the adventurer, will find their haven in the wilds of South America, Mexico, and Canada, but the higher type possessing some of the world's wealth, who have left their homes with some adventurous idea, it is true, but yet imbued with that higher idea with which our own citizens are endowed, will seek our shores for their permanent abode, because we have here everything to offer them in the way of the good things that life possesses.

The entire Pacific Coast presents opportunities for all who may desire to cultivate its soil or become a part of its commercial development. With every gift of nature, awaiting but the application of water, which can be pumped at reasonable figures by electrically operated mechanisms an empire of arid lands yearningly looks to the immediate future.

Elegance

In previous issues of the Journal we have called attention to the fact that above all other qualities of style in technical writing an engineer should possess clearness of expression. Second in importance we have found that, especially when an engineer through his written report desires to move men to action, his writing should possess force. We come now to a discussion of still another quality which seems to be almost totally lacking in technical literature of today, elegance of expression.

The gigantic commercial development among our industries has been such an absorbing topic in our matter-of-fact literature, the esthetic side of our engineering nature has been almost entirely neglected. Faint signs however of a new awakening looking toward this higher development are daily coming into our engineering life. Not so much is this true in the style of technical literature as in the style of engineering design.

A few years back a structure was built mainly to meet the matter in hand without any idea as to its beauty or the effect it might have upon the mental make-up or development of those who should cast their share of life's fortunes with it. But now we see the engineer arousing from his slumbers. The style of architecture in our power houses, the grounds surrounding them and even the carefully finished design of the machinery itself bears the stamp of evolution into a higher plane of engineering thought. Unquestionably such higher development will in the future imbue our engineers with a keener and higher appreciation of life and such higher ideals being instilled will induce greater loyalty and higher conceptions of obligation to the employer.

Elegance of expression or in other words, a style adopted to touch the esthetic side of our natures seems however wholly lacking in our technical literature. Why should we not, nevertheless, enrich our literature with this side of technical writing? It seems now to have permeated every other phase of our social and economic development.

Technical design and industry are having a deep and unspeakable influence in shaping our commercial and industrial progress. Why, then, should not the onward march of our technical literature tend towards heightening our general esthetic make-up? The one trait of expression which lends itself so wonderfully in appealing to our esthetic natures is that of adaptation to the matter in hand. Sympathetic vibration with those before whom our thoughts are to be presented can only be gotten by this adaptation which is technically called elegance.

Our technical literature with its figures and summarized facts have in the past largely served to portray socalled progress—money made or money lost. The eager technical reader in the recent years of unprecedented material growth has sat by and devoured the dry morsels thus handed out to him with the same avidity that the wild beast at the "zoo" takes hold of raw meat flung at him by the game tender, and if we listen we can almost hear our technical habits described by the loud-voiced one without as he yells: "Come in—come in—and see 'em—eats 'em alive."

No set rules seem to have ever been put forth by which one may attain elegance in expression. Like the symphony in the music of the spheres, one possessing elegance must be entuned with the Infinite. The true engineer in contemplating the wonders of scientific achievement has felt its inner charms. Should a Milton, a Dante, or a Shakespeare ever come to earth as an engineer it would indeed be difficult to foretell to what heights the ideals of men would be raised.

PERSONALS.

O. W. Lillard, Pacific Coast manager of the Gould Storage Battery Company, is at Seattle.

H. L. Middleton, who has local electric lighting interests at Boulder Creek, is at San Francisco

F. B. Baum, of F. G. Baum & Company, has returned to his San Francisco office from Southern California.

T. J. Patterson, who operates the United States Government wireless telegraph station at Juneau, Alaska, is at San Francisco.

R. G. Hanford, who is prominent in the management of the United Properties Company, is at New York on business of importance.

A. L. Walton has been appointed chief clerk to the general purchasing agent of the Pacific Electric Railway Company, of Los Angeles, Cal.

P. Endert, an electrical contractor of Bakersfield, is at San Francisco on business which is said to be connected with an oil land project.

George E. Pillsbury, chief engineer of the Pacific Electric traction lines of the Southern Pacific Company at Los Angeles, is at San Francisco.

J. W. White, of the sales force of the Fort Wayne Electric Works, has returned to the San Francisco office after a tour of Southern California.

H. V. Carter, president of the Pacific States Electric Company, left for Portland this week and will return to San Francisco about the end of February.

F. R. Ford of the New York engineering firm of Ford, Bacon & Davis, has arrived from the East and will spend some time at the San Francisco office.

R. S. Daniels, assistant to the electrical engineer of the Washington Water Power Company of Spokane, has been visiting in Los Angeles and is now at San Francisco.

Frank M. Lewis, in charge of the construction department for the Van Emon Elevator Company, left San Francisco Monday for his new field of duties in Vancouver, B. C.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard and Supply Company of Chicago, leaves the first of next week for a business tour of Southern California and Arizona.

A. C. Balch, who is interested in the management of the San Joaquin Light and Power Corporation, and is also a shareholder in the Midway Gas Company, was a recent arrival at San Francisco.

A. H. Koebig and A. H. Koebig, Jr., consulting hydraulic and civil engineers, have removed their offices from 902 Broadway Central Building to suite 841 Title Insurance Building, San Francisco.

Harry R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco after an extended stay in the Pacific Northwest, where his firm has two branch offices—at Seattle and Portland.

William Hoopes, electrical engineer for the Aluminum Company of America, with works at Pittsburg, is at San Francisco, making his headquarters with Pierson, Roeding & Co., the Pacific Coast agents for his firm.

J. S. Cain of Bodie, who has been prominent in mining enterprises there for a quarter of a century, and during the past few years has founded the Pacific Power Company and the Southern Sierras Power Company, spent the past week at San Francisco in connection with plans for the completion of the latter development.

Chief Engineer Stowell of the Mt. Whitney Power Company, of Visalia, is at the Lane Hospital, San Francisco, undergoing treatment, but will soon be out.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, leaves the first of next week for Seattle and will spend several days at the Northwest agency.

Tully R. Connick, contracting engineer on steel tower transmission lines, of Petaluma, Cal., was an interested attendant at the recent San Francisco branch meeting of the American Institute of Electrical Engineers.

Ralph Bennett has resigned as chief engineer of the Great Western Power Company, San Francisco, to accept the position of chief engineer of the Dominguez Land Company, Title Insurance Building, Los Angeles.

Albert Meinema, city sales manager of the Electric Appliance Company's San Francisco house, has been elected a member of the National Sales Managers' Association. A branch of the association was recently organized at Los Angeles.

R. D. Holabird, president of the Holabird-Reynolds Company, who returned to San Francisco during the past week after visiting the Pacific Northwest, will in future spend about half of his time at Seattle with the Holabird Electric Company.

Y. Ishakawa, electrical engineer in charge of the 10,000 h.p. steam and hydroelectric installation of Kyoto, Japan, was a recent interested spectator at the test of the new 12,000 kw. turbine at Station C of the Pacific Gas & Electric Company, in Oakland.

S. P. Russell, manager of H. W. Johns-Manville Company's electrical department at San Franicsco, left for an eastern trip during the past week. While in the East Mr. Russell will attend the convention of the company's electrical managers.

R. J. Chapman has become associated with J. W. Swaren, technical advertising consultant at San Francisco. Mr. Chapman has had a wide engineering experience, and for the past four years was general manager of the Fowler Utilities Company, Fowler, Indiana. Mr. Chapman received his engineering training at Purdue University and Leland Stanford Jr. University.

J. H. Siegfried has resigned as superintendent of the light and power department of the city of Winnipeg to accept a position with the Pacific Power & Light Company as superintendent of power. In this position Mr. Siegfried will have jurisdiction of all generating stations, transmission lines and substations owned by the company in Yakima, Walla Walla and Columbia River valleys.

Robert McGlynn, who has been connected with the Smith-Tevis electric interests for the past four years, resigned his position as chief engineer of the four electric power stations of the United Light and Power Company at San Francisco, February 1st. After eleven years of active work in electrical engineering lines, Mr. McGlynn intends to spend a few months in travel, and then return to choose a new position out of several that have been offered him. It is understood that no successor is to be appointed as chief engineer.

Sam P. Russell, manager of the electrical department of the H. W. Johns-Manville Company's San Francisco office, is at New York to attend the forthcoming annual convention of the various managers of that department throughout the country. F. S. Mills, electrical manager of the company's Los Angeles branch, and F. W. Loomis, manager of the electrical department at Seattle, will also attend the convention. George G.

Gunderson, who was recently succeeded by Loomis, accompanied the latter to New York. For three days the convention will be held at New York and three days at Hartford, Conn., where H. W. Johns-Manville Company's factory is situated. J. H. Davler, Russell's assistant, is in charge at San Francisco during his chief's absence.

Garnett Young, manager of the San Francisco office of the Telephone-Electric Equipment Company, announces that the Seattle branch, F. G. Larflin, manager, has removed from the Manufacturers' Exchange Building to a choice location at 1002 First avenue South. The change was made absolutely necessary by increase in the business and three times the space occupied at the old location is now available.

SOUTHERN CALIFORNIA NEWS.

The city of Pomona will install a decorative street lighting system in their city park, within the next ninety days.

The city of Glendale will vote on a $10,000 bond issue, on February 2d, to be used for extensions and betterments on their municipal lighting plant.

The Pacific Electric Railway Company has been given 90 days to relieve the congestion on Main street. How this is to be done the council does not suggest, but simply states that it must be done.

The local fire alarm situation in Los Angeles is still in abeyance, the matter now being in the hands of the city attorney, to submit his opinion on the legality of the specifications. The matter is still too indefinite to give any reliable information, but the subject is certainly one that is becoming very interesting to the observer.

The City Council of Los Angeles passed an ordinance forcing the lighting and telephone companies underground, in a district comprising two miles of streets in the business district. The exact locations have not been determined as yet. They also decided against a petition from the residents on Moneta avenue for an underground system comprising about two miles.

The Los Angeles council has rejected the compromise offered by the Home Telephone & Telegraph Company, regarding the rate controversy and have recommended another expert to be employed to reappraise the plant. This plant has already been appraised by Mr. Sloan, of the Public Utilities Commissioners of Wisconsin, and Mr. Kempster B. Miller, but because their report carried with it a recommendation for the increase in rates, the council would not accept it as final and are still endeavoring to reduce the rate, instead of bringing it up equal to the Pacific Telephone & Telegraph Company's rate.

LOS ANGELES SECTION A. I. E. E.

At the meeting held January 23d two papers were presented, one by Mr. E. Y. Porter, on "Show Window Lighting," and one by Mr. F. B. Lewis of the Edison Company, on "Practical Illumination. These papers were discussed by Prof. Nye, of the University of Southern California, who gave some interesting lantern slides of color effects, also Mr. Mills, of the Johns-Manville Company and Mr. Manahan, city electrician, also a general discussion by different members. Mr. Lewis gave a practical demonstration of his paper, showing the light effects as reflected by different colors, explaining the results to be had by given illumination in rooms finished in different colors. The papers were interesting to the members present, inasmuch as it is a subject that has been very much neglected and is of really great importance, not only in residences, but offices and elsewhere.

SAN FRANCISCO SECTION A. I. E. E.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers met at the Home Telephone Company's building Friday evening, January 26. An interesting paper was read by Otto E. Falch on the design of transmission lines. This paper was followed by a lantern slide lecture on the Stanislaus transmission line construction by H. W. Crozier. Mr. Crozier's paper appears elsewhere in these columns. Mr. Falch's paper will appear in the next issue of the Journal.

MEETING NOTICES.

The San Francisco Section of the American Institute of Electrical Engineers will give a dinner at eight o'clock, Saturday evening, February 3d, at the Old Poodle Dog Restaurant, 421 Bush street, in honor of Bion J. Arnold, past president of the Institute.

The Electric Development League will hold its regular monthly luncheon on February 6th at 12:30 p. m., at the Press Club rooms in the Commercial Building, 833 Market street. A debate will be held on the question, "Resolved, That it is to the best interests of central stations to sell incandescent lamps." All electrical men are invited to attend.

NORTHERN CALIFORNIA NEWS.

President H. H. Noble announced that the Northern California Power Company has completed negotiations for the purchase of the properties of the Sacramento Valley Power Company. Two hydroelectric plants are included in the sale. The Sacramento Valley Power Company represents a merger which was effected about a year ago, of the Shasta Power Company and the Northern Light and Power Company. Herbert Fleishhacker and Mortimer Fleishhacker of San Francisco and E. B. Smith of Redding are members of the selling syndicate.

Northern California Power Company's system.

The two plants acquired in Eastern Shasta County will be tied in at once with the five hydroelectric stations of the

ELECTRICAL CONTRACTORS' NOTES.

E. C. Burkhard, of Palo Alto, was in San Francisco recently on business.

W. S. Hanbridge spent last Monday in Sacramento and Tuesday in Stockton on electrical contractors' business.

H. C. Reed superintendent for the Pacific Fire Extinguisher Company, is at Portland looking after the company's interests there.

Mayor Rolph of San Francisco has called together a committee of contractors, composed of P. Decker, F. Watts and W. S. Hanbridge, in conference with Police Commissioners Cook and Woods, Fire Commissioner Brandenstein and Supervisor McLaren, chairman of the Building Committee. The subject of discussion was in reference to the Chief of Department of Electricity. The contractors were asked in reference to the ability of a number of applicants for the position. The subject of the alleged incompetence of the present chief was spoken of quite freely, but contrary to all daily paper reports, the contractors filed no charges against the chief. The contractors impressed upon the administration that they did not want to name a new chief, but to make sure that the man who would be appointed would give the contractors, dealers and consumers a fair deal, and at the same time not jeopardize the utility of the fire alarm telegraph systems.

The list of names submitted is a good one, with a couple of exceptions, and from such a body of men the city officials will find a man who will be a credit to the office.

INDUSTRIAL

PRINTING PLANT.

Progressive printers are beginning to realize the manifold advantages of an electric drive for their printing shops. They readily perceive how easy it is to eliminate the long lines of shafting with belts to each machine dripping oil, difficulty of speed changing and the lack of economy in running all the shafting when it is desired to operate only one machine.

By the use of individual electric drive, machines may be located in the most convenient places for the work they are to perform, rather than in a row so as to be driven from one line shaft. In this manner, each operator can run his machine regardless of the others. The shop of Kohn & Pollock, Baltimore, Maryland, is an excellent example of the improvement to be secured from the electrification of a printing plant.

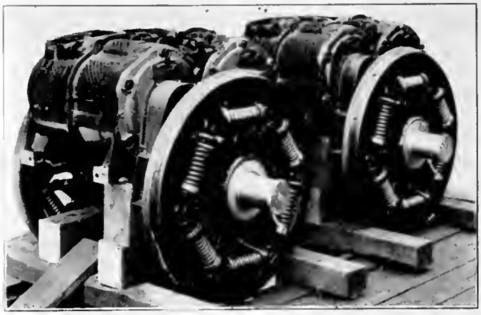
Motor Driven Paper Cutter.

Since the installation of individual motor drives, the average cost of energy per month has decreased, and in addition, when the output of the plant was curtailed for any reason, the power bill was decreased in proportion, which, of course, was not true under the former system. The electrical equipment of the plant includes fifteen constant speed direct current Westinghouse type R motors, aggregating 21½ horsepower. All of the motors were furnished by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

DEVELOPMENT IN RAILWAY APPARATUS DURING THE PAST YEAR.

During the year just past, considerable progress has been made in the development and improvement of electric railway apparatus. The increase in the number of applications of the single-phase system has been particularly noteworthy. The latest single-phase locomotive built by the Westinghouse Company is equipped with four driving axles. There are two single-phase motors geared to a quill surrounding each axle. This arrangement, which at first appears more complicated, is in reality, a lighter, cheaper, and more simple construction than that involving four motors of the same total capacity.

Most of the troubles on pioneer single-phase railways were due to operation at abnormally high speeds, at speeds higher than those for which the equipments were designed. These high rates of speed were possible because the line voltage was always good and because the transformers were usually supplied with over-voltage taps. Furthermore, the motors had very steep speed characteristics, which permitted them to reach a higher speed than would be possible with a direct current motor with the same gear ratio. This source of trouble is now eliminated in Westinghouse equipments by the use of an overspeed relay, which is electrically operated, and is controlled by the current and voltage applied to the motor through the control circuit. When the speed of the motor reaches a certain predetermined limit, the control circuit is opened on the higher notches of the controller. This makes it impossible to operate the cars above the limit unless there is a long stretch of down-grade, which is unusual on interurban lines. In any event, excess speeds are possible only when there is no power on the motors. This method of protection might safely be applied to direct-current motors, since extremely high speeds are not only dangerous, but in nearly all cases are unnecessary. High speeds are a source of expense because of the extra energy consumption



New Type of Mounting Motors in Pairs on Each Axle.

TRADE NOTES.

The Stanton Dielectric Rubber Company of Muskegon, Mich., because of a conflict in names will hereafter be known as the Vulcanized Products Company and their dielectric material called Dielectrite will be renamed Gohmak.

The Moloney Electric Company of St. Louis, with works at that city and at Windsor, Canada, have opened a San Francisco office, in charge of R. B. Elder, in his permanent office on the ground floor of the Rialto Building. The Moloney Electric Company specialize exclusively on the manufacture of transformers and the San Francisco office is fully equipped with such detailed information as may be required by any purchaser.

NEW CATALOG.

The Worcester Polytechnic Institute has just issued an attractive catalog of 250 pages covering items of interest concerning the Institute for 1911-1912.

NEWS NOTES

INCORPORATIONS.

SAN JOSE, CAL.—Saratoga Telephone Company, for $9000, shares at $10 each, $1560 subscribed by A. B. Brolly, F. J. Currier, R. L. Hogg, J. A. Kerr, L. J. Church and others.

ILLUMINATION.

GERVAIS, ORE.—An agitation is being set on foot for electric lights in this town.

WESTON, ORE.—The Preston-Shafter Milling Company, Athena, will rebuild its light plant here and install modern machinery.

WOODVILLE, ORE.—The Rogue River Electric Company will supply electricity to the town as soon as the transformer station is completed.

PORTLAND, ORE.—The Oregon-Idaho Light & Power Company has been granted a franchise for an electric light plant, power and heating service; the city is to establish the rates.

BELLINGHAM, WASH.—Business men here are agitating the purchase and installing of cluster lights on parts of Holly, Bay and Prospect streets, 50 in all, for which the cost will be about $3750.

PARIS, IDAHO.—The Telluride Power Company has been granted the right to maintain an electric light and power transmission system on and over the streets, alleys and public places of this city.

ELLENSBURG, WASH.—S. Bornstein, of Seattle, made application to the City Council for a gas franchise; he offers a guarantee of $2000 and a gradually increasing percentage of the gross receipts.

GLENDALE, CAL.—A special election will be held February 2 for the purpose of voting on the question of issuing $40,000 in bonds for acquiring, constructing and completing a municipal electric light works in the city.

BELLINGHAM, WASH.—An appropriation of $6000 from the funds of the water department was made by the City Council for the purchase and installation of the required equipment for the proposed city auxiliary electric lighting plant.

NEVADA CITY, CAL.—The trustees have decided to take up the project of establishing a municipal lighting system. The Pacific Gas & Electric Company, which owns the system now supplying the city with light and power, will be asked to name a figure which it will accept for its plant in this city.

FRESNO, CAL.—W. N. Henderson, local manager for the Pacific Gas & Electric Company, announces that his company plans the erection of a $60,000 brick and stone structure for its offices in Fresno. The building and site will cost somewhere in the neighborhood of $50,000 and plans will be ready within a few weeks.

TRANSMISSION.

MODESTO, CAL.—The board has granted permission to the Sierra & San Francisco Power Company to maintain an electric transmission line in certain parts of Stanislaus county.

SAN FRANCISCO, CAL.—Kalenborn & Pahl, electrical contractors, report the completion of a difficult job of submarine cable work for the U. S. Government which has recently connected Angel Island with an 11,000-volt power cable to the mainland at Tiburon across Raccoon Straits.

BRIDGEPORT, WASH.—J. E. Brayton of the Nixon-Kimmel Company, Spokane, has asked the City Council for a franchise to construct light and power lines over the streets and alleys here.

LEWISTON, MONT.—The Butte Electric & Power Company will build a high tension power transmission line from Rainbow Falls to Lewiston this summer. The distributing system in Lewiston will also be rebuilt.

SEATTLE, WASH.—The contract for the complete electrical system for the 42-story L. C. Smith building, to be erected at the corner of Yesler Way and Second avenue, has been let to the Empire Construction Company.

HUSUM, WASH.—Work on the $1,000,000 power plant of the Northwestern Electric Company, four miles down the White Salmon River, will be pushed to completion as soon as the snow disappears. Large donkey engines were hauled up from Underwood, to be used in excavating for the concrete dam.

GARDNERVILLE, NEV.—William Scheele & Dick Thran have made application for a franchise right to operate an electric plant and transmit electricity along a certain route. The franchise calls for a period of 25 years. On March 4th at the office of the board, at Genoa, Nev., a meeting will be held for a hearing of the said petition.

SEATTLE, WASH.—Voters will be asked at the city election in March to approve bond issues of $1,000,000 and $640,000 for additional light and power sites on the White River and Lake Cushman, respectively, as the result of a meeting of the council. The issue, if approved, will include the purchase price of the land and the cost of installation of the power plants. It is proposed to utilize the Lake Cushman site for power for industrial establishments for this city. John C. Higgins, representing John E. Wickstrom, owner of the riparian rights and land in the tract, said that if the city declined to take over the lands they would be used for a private plant for the development of light and water power.

SAN FRANCISCO, CAL.—The work of laying 20,000 feet of cable from the Oakland shore to San Francisco, connecting the distributing stations of the Great Western Power Company and the City Electric Company has been completed. With the new cable in working order the San Francisco district of the Great Western Power Company will have a much improved service, getting its power directly from the main station on the Feather River, 165 miles away. About six months have been consumed in laying the cable, which is believed to be the largest and longest of its kind ever laid. The cable, which is six inches in diameter, will furnish 5000 kilowatts of power. It is protected by two shields of metal, one of lead and another of steel, with a compound substance between the shields. The cost of the power cable was about $250,000.

TRANSPORTATION.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been granted the right to electrify the Santa Monica air-line.

SALEM, ORE.—The Oregon Electric Railway Company promises to build a commodious new depot here within a short time.

PASADENA, CAL.—The Southern Pacific Company has been granted a franchise to extend its road out Washington to Wilmington street.

BILLINGS, MONT.—Trolleyless cars have been introduced on the electric system here. Power is drawn from storage batteries on the cars.

PHOENIX, ARIZ. An application for a franchise for the proposed White line to Mesa and Scottsdale, has been made by the Salt Lake River Valley Electric Railway Company.

MOSCOW, IDAHO. The Inland Empire Railroad will begin work at once on the new depot for this city, to be a duplicate of the new station at Coltax. The cost will be $4000.

BELLINGHAM, WASH.—Nooksack Valley Traction Company has secured an extension of the limit of its franchise for the construction of an electric line. Work must begin within nine months.

BOTHELL, WASH.—A. K. Rouse, representing Chicago capital, has asked for a franchise to build an electric line in Bothell, for street cars and light. The line is to be built into Seattle later.

NAMPA, IDAHO.—The Southern Idaho Heat, Light & Power Company has secured a site for a depot for the Nampa-Caldwell electric line. A fine depot will be constructed this spring.

MARSHFIELD, ORE.—Directors of the Terminal Railway have ordered work to proceed on the first mile of the line out of here. Two electric passenger cars will be ordered at once in San Francisco.

EL PASO, TEX.—The Stone-Webster corporation is considering the project of constructing a valley electric line from El Paso through El Paso valley to Socorro or some other point in the lower part of the valley.

LOS ANGELES, CAL.—Vice-President Paul Shoup of the Pacific Electric Railway has announced that the company will spend something like $100,000 in improving its terminal facilities at Sixth and Main streets.

SUTTER CITY, CAL.—Offers of a free right-of-way and the purchase of stock of the Marysville-Colusa Railroad have been made to the Northern Electric Company, which will build through to Sutter City.

WENATCHEE, WASH. Bonds of the Wenatchee Valley Railway & Power Company have been sold to the amount of $1,000,000. The company will construct a trolley from Malaga to Leavenworth, 60 miles long.

LEBANON, ORE.—A surveying crew is at work running lines up the Santiam River. No information is available, but it is believed the crew is in the employ of the Oregon Electric and that a line to Sweet Home will be built.

LOS ANGELES, CAL.—The new shops of the Pacific Electric Railway Company at Dominguez, the industrial city, will be built at a cost of $750,000 instead of $250,000 as previously announced, according to a statement of Paul Shoup, vice president.

SACRAMENTO, CAL.—The Vallejo & Northern Railway Company has applied for a franchise for lines on Second street, between K and M streets, and thence on M to the middle of the Sacramento river, and on Front street, from R to M, and thence to the center of the river.

MONROVIA, CAL.—General Superintendent Pratt, Division Superintendent Whelan, and other Southern Pacific officials, inspected the Los Angeles-Monrovia spur of the Southern Pacific recently. The party came in a special train and devoted considerable time to a careful investigation of switching and yard facilities at the station. No hint of the purpose of the trip was vouchsafed but it is believed that the often-discussed project of electrizing the line is again under consideration. The announcement that electric traction will soon displace steam on the Los Angeles-Pasadena branch supports this conjecture, which is further strengthened by the fact that the region traversed by the Monrovia line is rapidly building up and only awaits frequent service to become as densely settled as the district contiguous to the Pacific Electric.

LODI, CAL.—It is reliably reported that the Central California Traction Company has secured rights of way for a branch line from its main Sacramento line at Galt road to Galt, and that it proposes to extend the branch line through Thornton and on to Walnut Grove on the Sacramento River.

PASADENA, CAL.—The Pasadena Rapid Transit Company, whose aim it is to establish a twelve-minute railway service between this city and Los Angeles, has taken the first step in proceedings for the creation of a bond issue to finance the undertaking. At a recent meeting it was decided by the company that the proposed bond issue will be $2,000,000 instead of $3,000,000 as was contemplated.

STOCKTON, CAL.—In all probability the Central California Traction Company will shortly apply to the City Council for a franchise to operate its lines along Tuleberg Levee to the Crown Mills. Councilman O'Keefe suggests that the city build a belt line on the waterfront and allow all companies to use it.

FOREST GROVE, ORE.—The council has granted a franchise to the Oregon and California Railroad Company, which grants the right to lay, construct and maintain street car tracks and to operate and maintain power, telephone and telegraph lines in this city. Construction work is to be completed within 8 months.

TELEPHONE AND TELEGRAPH.

GLASGOW, MONT.—The operating room of the Moore telephone exchange was destroyed by fire recently.

ST. JOHNS, ORE. The Mount Hood Railway and Power Company will as soon as possible install their own telephone system in their plants and offices.

MEDICAL LAKE, WASH. Negotiations are on for the purchase of the Medical Lake telephone line by the Pacific States Telegraph & Telephone Company.

EUGENE, ORE.—A. E. Cohoon, supervisor of Suislaw National Forest, is seeking a franchise over roads in western Lane county, for a government telephone line.

SEATTLE, WASH.—Word is received here that the Marconi Wireless Telegraph Company will equip fourteen vessels on the Pacific Coast and that in a short time the company will open a station in Seattle.

WALLA WALLA, WASH.—The Western Union Telegraph Company's office in this city are to be moved from their present quarters in the Pain building on South Second street to the Pedigo-Lonoy building on North Second street.

GOLDENDALE, WASH.—The Lyle Telephone Company has been granted permission to maintain a telephone line along the public highways in the districts tributary to Lyle, upon the express condition that public travel shall not be interfered with.

MARTINEZ, CAL.—The Pacific States Telephone & Telegraph Co. directors met here the other day and re-elected Henry T. Scott of San Francisco, president; E. C. Bradley, vice-president and general manager, and F. W. Eaton, secretary and treasurer, in addition to twelve directors. From now on the directors will hold their meetings at the general offices in San Francisco.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, FEBRUARY 10, 1912 | NUMBER 6

DESIGN OF HIGH TENSION TRANSMISSION LINES[1]

BY OTTO E. FALCH, Jr.

Power transmitted over high tension lines is generally obtained from the natural flow of some river combined with artificial storage in reservoirs. In a plant of 2,000 ft. head, a flow of 1 cu. ft. per sec. represents 120 kw.-hr. or 30 cu. ft. of stored water per kw.-hr.

The design of these lines is generally based on the results of a thorough investigation of the requirements for each particular case. In a steel tower line of say 2,000 towers where every 100 pounds of unnecessary steel per tower represents a waste of approximately $10,000, the importance of the proper selection of spans between towers is apparent. This is especially more striking in hilly country than on level land. In hilly country the average span is generally longer than on level land when using towers of the same height.

After having the line properly surveyed and plotted in profile, the only way to secure a satisfactory line is to determine, step by step, the location of each tower, as shown in Fig. 1. First a catenary is drawn to the same scale as the profile and cut out of a sheet of heavy profile paper or other material.

Starting with the tower A at the top of the hill and placing the catenary as shown it is seen that the lowest point of the catenary is not always the nearest point to the ground.

Point E is the lowest point of span AB, but G is the point of minimum clearance. G determines the location of the next tower B.

The minimum clearance varies between 20 and 30 ft., depending upon the location of the line. Thus with a definite clearance, a predetermined tower height the points of support, A, B, C, etc., become fixed. The maximum sag, occurring at the highest temperatures met with, must be considered here with wind conditions disregarded.

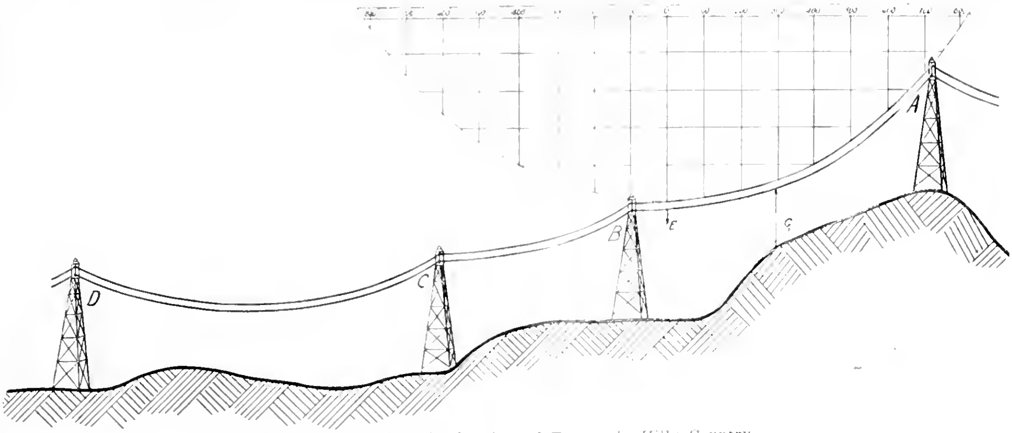


Fig. 1. Illustrating the Spacing of Towers in Hilly Country.

But let us assume that a wind of maximum velocity is blowing at right angles to the line as shown in Fig. 2. In a long span AB, followed by a shorter span BC, the downward pull on the insulator at B is not sufficient to prevent this insulator from swinging through an angle such that the conductor is placed within a dangerous proximity to the steel tower, as is due to the resultant of the wind component on point 2. This is due to the resultant of the wind component on spans A B and B C being relatively large in

[1]Presented before the San Francisco Section of the A. I. E. E., Jan. 26, 1912.

comparison to the weight component, which is only that part of the span B C from B to the lowest point of the catenary in addition to a similar portion of span A B, the small part between B and E. So here we have another factor to consider in the spacing of the towers.

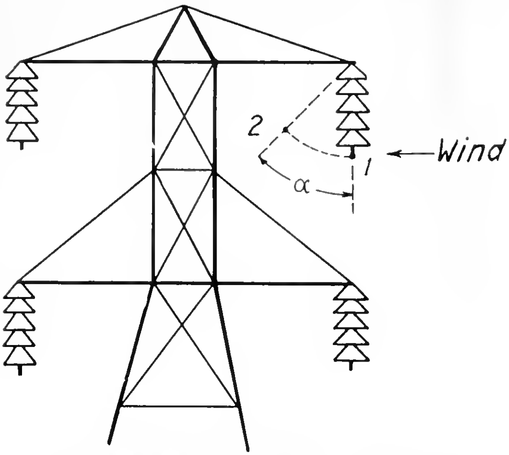


Fig. 2. Wind Must Be Considered in the Spacing of Towers.

Fig. 3 shows graphically the analysis of cable strains due to maximum conditions of load, wind and temperature. Spans are plotted as abscissae and cable tensions as ordinates. Let us start with the maximum allowable cable stress, which, of course, must be within the elastic limit of the material used. Taking a value of 25,000 lb. per sq. in. for copper we get a maximum value of 2,610 lb. for the specified cable. This is represented by the straight line A and may be taken as the horizontal tension. Similarly curve B represents the maximum horizontal tension at the insulator if it is assumed that the tension tangent to the catenary at the point of support is represented by the line A. The angle which the conductor makes with the horizontal at the insulator becomes greater as the span increases and thus an increase of the tangential tension in the line at the insulator over the horizontal tension at the middle of the span.

The next step is to plot the curve C, showing the tensions without wind or ice as the case may be at the same minimum temperature. The decrease in load on the cable results in a corresponding decrease in tension until a new deflection is reached where the tendency to contract due to the modulus of elasticity of the material balances the gravity stress in the cable.

In a similar manner, curves are plotted for the various changes in temperature by taking into consideration the coefficient of expansion. This results in a further decrease in tension due to the lengthening of the conductor and at the same time contract elastically due to this decrease in tension within the elastic limit resulting in a new deflection.

It is necessary to properly combine and substitute in various equations involved to obtain values with which to plot these curves. With the chart once made

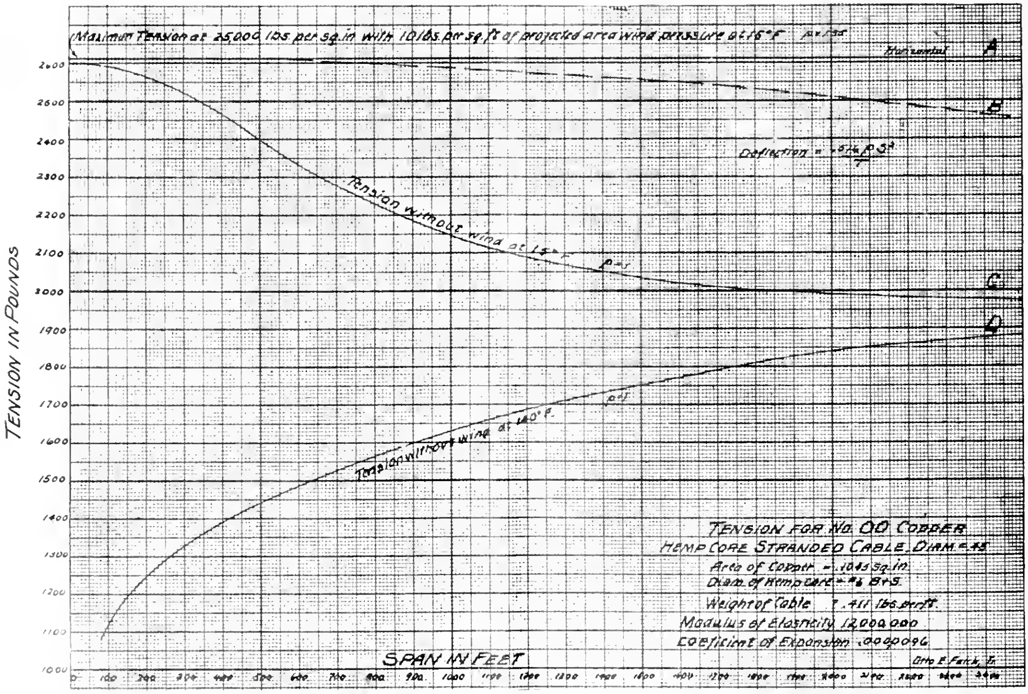


Fig. 3. Graphic Analysis of Cable Strains.

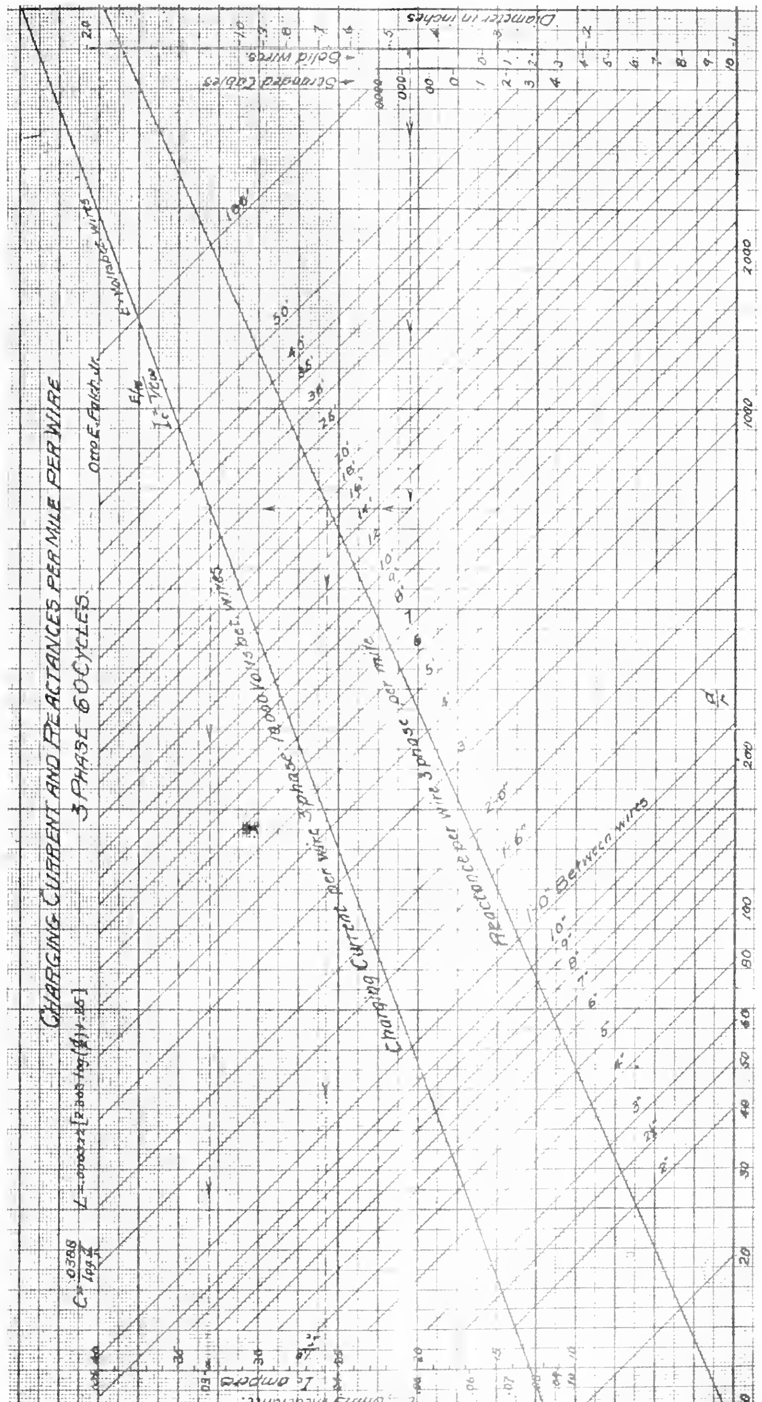


Fig. 4. Chart for Determining Charging Current and Reactance on Long Transmission Lines

the immediate use of all quadratic equations or of approximate methods can thus be avoided. An article covering the complete and exact solution of the equations of sag and tension, would be too long to include here. It is always well to have a check on the various approximate methods, when working out some important problem. For new conditions now arise with steel core aluminum cables in which the sag is less than with copper of the same conductivity as the steel carries the entire load at the higher temperatures similar to ice-covered cables. Let us, then, look into a particular illustration of the method involved.

The deflections corresponding to the tension shown in the curves are found from the equation $D = \frac{pwS^2}{8T}$, where p is the ratio of resultant weight of wire, ice, and wind to the weight of the wire, w is the weight of a foot of wire 1 sq. in. in cross-section which is 3.85 for copper and 1.155 for aluminum, S is the span in feet and D is the deflection in feet $\therefore$

$D = \frac{.481pS^2}{T}$ for copper by substituting the value of $\frac{w}{8}$

For a No. 00 copper cable with a hemp core $D = \frac{.494pS^2}{T}$.

If the horizontal tension T^1 in the cable is used, instead of the tension T in lb. per sq. in., with no wind and ice $p = 1$, therefore $D = \frac{.05S^2}{T^1}$.

For aluminum cables $D = \frac{.145pS^2}{T}$ by substituting the value of $\frac{w}{8}$.

For steel cables $D = \frac{.427pS^2}{T}$ by similarly substituting the value of $\frac{w}{8}$.

For cables with steel cores as aluminum with steel cores, or copper clad wire, similar equations can be made for the different sizes of wire, taking into account the different proportion of the different metals.

In the selection of the proper size wire required for the power to be transmitted, the chart as plotted in Fig. 4 will be found to be very valuable in solving the problems for lines of considerable length, where the effect of line capacity becomes quite a question.

On this chart values of $\frac{d}{r}$ are plotted as abscissae, to a logarithmic scale, with values from 10 to 2000 where d represents the distance between conductors in inches and r the radius of the conductor in inches. On the right hand ordinate there is laid off, also to a logarithmic scale, the various sizes of stranded and solid wire cables in B & S gauge, with their corresponding diameters in inches. For special cables such as copper with hemp core or aluminum with a galvanized steel core the actual diameter in inches can be used.

The parallel straight lines making an angle of 45 degrees with the abscissae represent the distance between wires of from 1 inch to 100 feet, thereby covering a range of any spacing of wires that is liable to come up in problems even outside of transmission line calculation.

One of the ordinates at the left hand side marked I_c represents the charging current in amperes per mile per wire, 3 phase at 10,000 volts between wires. This is used in connection with the straight line marked Charging Current and is read diagonally across the entire chart. This curve becomes a straight line only when the values of the reciprocal of the charging current are plotted on the ordinate I_c to an evenly divided scale instead of the actual values. The reciprocals from 10 to 40 are marked on the right hand side of the line I_c and the actual values are shown on the left hand side ranging from one-tenth to twenty-five thousandths of an ampere charging current.

On the left hand ordinate, there is also plotted to an evenly divided scale the ohms reactance per wire, three-phase, to be used with the corresponding reactance line extending diagonally across the chart.

Suppose, as an example, we have a 104,000 volt three-phase line 136 miles long on which we are using a hemp core copper cable 45 hundredths of an inch in diameter with an average spacing of 12 ft. Start at the point .45 inches on the right hand side of the chart and then read horizontally to the left to the intersection with the 12 ft. spacing. From this point look vertically upward to the intersection with the diagonal line for charging current. Here we read at the left hand side the charging current and find it is equal to .0303 amperes per mile at 10,000 volts between wires. Therefore, the 136 miles at 104,000 volts the charging current is equal to 42.8 amperes at 60 cycles per second. This is equivalent to 7730 kilowatt amperes.

In the same way let us start from the right hand side of the sheet at .45 in. and note the intersection with the 12 ft. spacing. Looking upward to the intersection with the reactanace line, and then horizontally across the sheet, we read at the extreme left of the chart .815 ohms reactance per mile per wire at 60 cycles. For 136 miles this becomes 111 ohms.

Now with the triangle shown over Fig. 5 the characteristics of any transmission line can be determined. The method is a simplification of some of the older graphical ones.

Let $AB = -j\frac{I_c R}{2}$, the reactance drop due to the charging current over one wire.

$BC = \frac{I_c L\omega}{2}$, the resistance drop due to the charging current over one wire.

$CD = I \cos\theta R$, the resistance drop due to the power component of the load.

$DE = -j I \cos\theta L\omega$, the reactance drop due to the power component of the load.

Where I = the current in the line.

I_c = the charging current.

R = the resistance.

j = the letter used in solving equation by complex quantities to distinguish the vertical component from the horizontal component.

L = the self induction of the line.

$L\omega$ = reactance due to the self induction.

θ = the angle whose cosine is the power factor of the load.

Having found the values of these four quantites in percentage of the voltage at the receiver end, the rest of the solution is performed graphically by means of a triangle which is made of celluloid or other material. The base of this triangle MN is divided into any number of metric divisions depending upon the accuracy which is desired and is used as a scale for the remaining construction. Each of these divisions represents a value of one per cent. From a center O on NM extended, an arc MP of any convenient length is described with a radius of 100 divisions. For example, if one cm be taken as one per cent the radius of this arc becomes 100 cm.

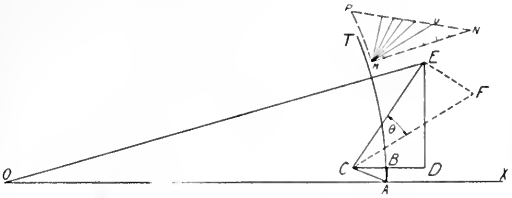


Fig. 5. General Construction for Fig. 6.

In the following example,—for a line of #00 B. & S. copper 136 miles in length, with a spacing of 12 ft. between wires, a resistance per wire of 56 ohms and with 20,000 kw. delivered; AB = 2 per cent, BC = 4

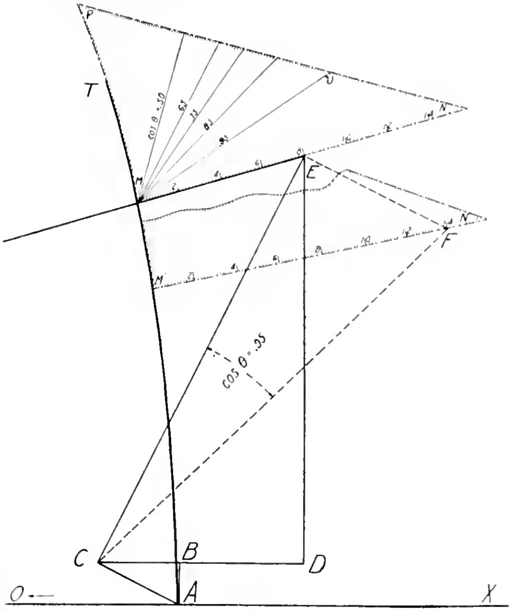


Fig. 6.

per cent, CD = 10 per cent, and DE = 20 per cent at unity power factor.

With my scheme it is not necessary for every problem that has to be solved to draw the arc AT with O as a center as shown in Fig. 5, if a triangle PMN shown in larger scale in Fig. 6 has been made having the arc MT cut to the same radius as AT, it is only necessary to draw on the line OX the arc AT with the arc MP of the triangle by placing MN along AX. Construct the right angle triangle ABC and CDE also with this triangle with AB = 2 per cent (2 units), BC = 4 per cent, CD = 10 per cent, and DE = 20 per cent.

Now place the arc MP of the triangle on arc AT so that the base MN passes through the point E. Here at E is read on MN 8 per cent, which is the regulation at unity power factor.

On our triangle with M as center are laid off several value of θ, that is $\cos^{-1}$ .95, .85, etc. For any other power factor as for example 95 per cent lay off angle ECF by placing MU along EC and obtain line CF. The length is determined by EF which is perpendicular to CE. As before, slide the arc MP of the triangle along AT until the base MN passes through F. We read a regulation of 14 per cent at a 95 per cent power factor.

In a similar manner examples have been worked out, thereby determining the characteristics of the Stanislaus line of the Sierra and San Francisco Power Company into San Francisco which check with actual tests at various loads and where we are operated at approximately 99 9per cent power factor.

Notice of Errata.

On page 89 of the Feb. 3, 1912, issue of this journal it is stated that the total interruptions to service on the Stanislaus transmission system for a period of fifteen months were twenty-four hours. This should read less than one hour.

In Fig. 6 a line should be shown at right angles to the base of the triangle inside the arc AT.

THE ELECTRICAL DEVELOPMENT LEAGUE.

Ninety-five members gathered at the newly organized Electrical Development League in San Francisco on Tuesday, February 6th, at the Press Club rooms. A month ago the total enrollment showed fifty-one members so that enthusiasm seems to be of a high order.

The program of the meeting was opened by an interesting paper on publicity which was read by James Redpath of the advertising department of the Southern Pacific Company. This paper is to be found below.

Then followed a debate on the question: Resolved, that it is the best interest of the central stations to sell incandescent lamps. Messrs. Holabird, Thieben, Carrigan and Stowe upheld the negative while Messrs. Leach, Neiman, Walton and Holberton battled for the affirmative. The discussion was thoughtfully listened to by all present. The judges, consisting of James Redpath, George J. Henry Jr., and Professor C. L. Cory, rendered a decision in favor of the affirmative.

The Publicity Committee displayed four separate ideas for general newspaper advertising and advanced new and suggestive methods of making this most effective. The discussion created a profound impression among the members. The report of the Publicity Committee is as follows:

We have in mind several forms of publicity campaigns, consideration of any one of which will occupy an entire meeting, and as others are to be heard from today we will pass them up for the moment and treat with the campaign suggested at a previous meeting—that of a weekly electrical newspaper page.

In laying out these pages it has been the object to have the illustrations so placed as to catch the eye, attract attention, and arouse curiosity or interest on the part of the reader in turning over the pages—objects which should be the foundation of all advertisements and especially ours.

Now as to copy. The magnitude and variety of the commodity to be dealt with we feel calls for the use of what is known as the "bulls eye" copy—that is—a few short, crisp facts that the eye involuntarily forces upon the brain of the reader with a minimum of effort rather than a congested mass of matter which few, if any, would take sufficient time to read, and if read—just long enough to determine the fact that it was an advertisement and then drop.

Each advertisement should carry a "reason why" —for example,—"Once hot—always hot,"—In other words reminding the housewife in a suggestive way of no more wood or coal fires to keep up while ironing, no more hot stoves to stand over, or rooms to put up with, and consequent colds, and, incidentally, a saving in fuel bills.

Now this brings us to the point where we are going to be asked questions. This is what we hope to get out of our display advertising. It is the evidence to us that the public is getting interested. To take care of these inquiries we should have something with which to follow them up. This "follow-up" material should be in the form of booklets,—at least two in number; one that will give a reasonable amount of detailed information to the person interested in household articles for instance; the other, one that will satisfy building contractors, and architects,—that will indicate to them the simplicity and ease with which arrangements can be made in the construction of a house, whereby the various electrical labor-saving devices of the household may be installed.

You ask the question, "Does advertising pay?" We answer, "Properly, honestly and intelligently done, —yes." What would this great Western country of ours have amounted to if the builders of the first railroad, after completion of the line, had laid down and waited for business to come to them? Did they do it? No. They saw they needed business to make the road pay. To get this business they neded settlers. To get settlers they advertised.

And, gentlemen,—you are in the same boat. You have persevered until you have mastered the mighty giants of the Sierras and with a tiny copper thread have led them from their mountain strongholds to our very doors to perform our heavy labors; to move mountains; fill chasms,—that the world's great highways of commerce may be shortened; to help us home after the close of toil. Yes,—so humble have you made these mighty forces that they may be carried around in our pockets, done up in tiny packages, called on at will to guide our footsteps along dark paths.

How may others get better acquainted with these forces? ADVERTISE.

DINNER TO BION J. ARNOLD.

The San Francisco Section of the American Institute of Electrical Engineers gave a complimentary dinner on the evening of February 3d to Bion J. Arnold, past president of the Institute and engineer in charge of the traction study at San Francisco. About eighty members and guests were in attendance and a most enjoyable evening held.

The principal address of the evening was given by Mr. Arnold, the toastmaster being H. A. Lardner and other speakers Geo. C. Holberton, J. R. Bibbins and J. G. DeRemer. Mr. Arnold's address follows:

I suppose you are somewhat interested perhaps in the particular problem that I am here over. I want to say that San Francisco's problem I regard as quite a delicate one, at the same time a very interesting one. I hope to be instrumental in getting the various elements harmonized if possible upon some kind of settlement, if you may call it that, or some kind of a program which will allow the various discordant elements of the city to work harmoniously toward producing a street car service in the city which will be satisfactory to the citizens as well as to the operators of the properties, and in time such as will enable them to give service to the great Exposition which you are going to have here in 1915.

I stand on this principle fundamentally that the investments, the legitimate investments in property can and must be protected, that is, in privately owned property. What that investment is, is a question to be analyzed. It has been analyzed in other cities, and, of course, the view of the municipality as to the value of the investment, and of the corporation owning the investment, is usually at variance, but there is some value there. When the value is found and agreed upon, that value shall be protected in such a way that when the franchise shall expire the company will know that it is going to get that value out of the property, and not going to have it taken away from it simply because of the fact that the franchise has expired. In other words, it ought to be possible for the companies holding such franchises and for the municipality to agree on some date that the franchises will all expire, and that after that date the company shall be allowed to continue to operate until the city purchases the property, if it choses to do so, or till it makes some other satisfactory arrangement with the company. This is the fundamental principle that I am going on. It has succeeded in Chicago, and I am in hopes that the idea may succeed here.

I suppose you are all more or less familiar with the settlement in Chicago made there upon the basis of agreeing with the company in advance on the value of the properties, a price which the city would pay the company in case it ever saw fit to purchase. They found a certain price, and the municipality agreed to pay that price, plus whatever money was added to the property from time to time under certain conditions, so that the city of Chicago knows any day the price it would have to pay for its street railway properties in case it ever sees fit to purchase them, and it can purchase them any time it so indicates its desire to do so and pays the cash for them.

Now, the companies there can operate during the life of their franchises, and after the expiration of the franchises, if the city does not purchase, they can op-

Dinner to Bion J. Arnold

erate under the same conditions that obtain in the present provisions. So we worked it out in Chicago, I think, in a satisfactory way.

In Cleveland they have settled it in another way. They there settled upon an ordinance which was the outcome of the influence of ex-Mayor Johnson, now deceased, who introduced the three-cent fare idea there, fought for it many years, and finally succeeded in getting it adopted, and they, like Chicago, also agreed on a valuation of the properties, a price that the city should pay in case it ever purchased; but they went one step further, and stipulated that the company should only be allowed to make six per cent and no more upon this investment. We in Chicago, believed that did not give sufficient inducement to the owners and operators of the company to warrant the kind of service that we thought Chicago wanted, so we gave to the company the right to earn 5 per cent upon its investment, and 45 per cent of the net after the property was properly operated and maintained and renewed. The companies then pay to themselves forty-five per cent of the net that is left, and the city gets 55 per cent of that net. That gives to the company something besides a bare return upon the investment, and makes what we believe is an inducement or reward for good service and for proper operation of the property. Cleveland has that incentive lacking. It limits their profits to 6 per cent. In Chicago we give them 5 per cent, plus what they can make, which has amounted to 7 and 8 per cent, and in one instance 10 per cent, and in one 6 per cent, besides putting into the city treasury about two million dollars per annum out of the profits of the company.

Now, the Cleveland ordinance did not prove entirely successful. They were to operate for a period of eight months under the three-cent ordinance, that is eight tickets for a quarter. The Cleveland ordinance stipulated that the citizens should have a three-cent fare, that is eight tickets for a quarter, so long as the company was able to operate and keep a reserve fund up to $300,000, this reserve fund being for the purpose of maintaining and renewing the property. Whenever the reserve fund drops below $300,000 then the fare was to be raised one cent per passenger, and when that reserve fund got up to $300,000 the fare was to be automatically reduced again a cent, so that this reserve fund acted as the surge tank for governing the fare that the citizens should pay, it being assumed that when it got to $300,000 the company was able to set aside enough for maintenance and when below that that it would not set aside enough. But in no event did the company get more than 6 per cent.

There was another provision in the ordinance, namely, that the companies could not sell securities except at par, and the city could not demand extensions. It was soon found that the company could not sell its security at par, and the city could not get any extensions. You got pretty crowded cars, and the service wasn't entirely satisfactory; so they have recently amended the ordinance which gives the company the right to sell its securities at something less than par. The discount, however, should be acceptable to the city. They have recognized you cannot always market a security, and they never did market a security on this property at par since the ordinance was passed.

There are other minor changes. One gives to the city the same authority by stating where the extensions should be, and they can demand extensions. They are acting now under the second trial period under this new ordinance. They don't know yet if they will be able to make the three-cent fare hold or not. They are charging a cent for transfers, which is returned to the passenger in case the transfer is not used. So they are under the second trial period of the Cleveland ordinance and we shall have to wait to see how it comes out.

We in Chicago believe that the Chicago idea is

better than the Cleveland idea, because it gives to the owner of the road an incentive over and above the bare return on its money. And those of you who are operating public utilities feel that you ought to have some reward besides an interest return on your money for staying on the job, because you can invest your money in a mortgage and get 5 and 6 per cent and not worry anything about it; but you cannot run a gas or electric property without some worry. You cannot even build them without worry.

Now, the question of franchise values is something that is being considered throughout the country. Those of us who organized companies twenty years ago, and some since, were disposed to and did place a value upon franchises, and rightfully enough we believed, because we judged properties not upon what they were really worth intrinsically, but upon what they could earn, that is, capital that they could earn a reasonable return on, and securities were sold on that basis. But in the last four or five years it has become, not fashionable (I will put it that way) to claim a franchise value because in many of the States they have laws which permit the State or municipality to regulate rates. Now, whenever a State or municipality has the right to regulate rates you can see that it is within its power to fix the rate so low that the advantage of having a franchise may be nil; consequently the franchise may have no value. Therefore, it is not wise to claim that it has a value, and few of us are claiming any more that it has a value, but we are rather standing upon the platform that we are entitled to earn a return upon the value of a property, plus a legitimate development expense, promotion expense, etc., but we are not claiming very much for franchise values, although we are claiming the right to live so long as the franchise exists, and claiming that we should make a liberal profit during the life of that franchise. I contend that any man or company that goes into a new field, creates a new enterprise, takes the chance of the thing being profitable or successful is entitled to something more than an ordinary return on his money. He is entitled not only to that return but he is entitled to a good liberal promoter's profit, if you please to call it that, or a good liberal profit of some kind to compensate him for having taken the risk of creating this property under new and adverse conditions. If you don't give to the individual or corporation, who takes those risks, that chance of reward, you are going to get no new properties created, no new inventions, nothing in the way of progressiveness that has tended so greatly and been instrumental in making this country what it is today, especially during the last twenty-five years, and especially in the field in which our energies have been directed. Suppose when these electric, light, power, gas and railroad properties were projected it was known that they would not be permitted to earn on their capital over 6 per cent, how many of you would have qualified yourselves as engineers to carry out your present occupations, or qualify to fill your present positions? It takes from you the incentive to do everything—I don't say anything—takes away from you what I considered the necessary incentive to develop new enterprises. I think that is being pretty well recognized by public utility commissions.

The Wisconsin commission has gone a step further, the Wisconsin State Railroad Commission, I believe it is called. They have gone so far as to say that the company, or individual, who has organized a company under such conditions and lost money on it from the start, is entitled to get that money back, plus a return upon it, and a reasonable promoter's fee and profit; and I believe that is a perfectly just proposition, namely, if you have gone in and created an enterprise, and operated it under adverse conditions in early years on the assumption you are going to be allowed to make large profits during subsequent years, I say, under these conditions when the public comes in and says, "We are going to regulate you, you cannot make these large profits that you anticipated," I say that the public should permit you to have an excessive profit during the subsequent years, or should reimburse you for your losses plus interests upon them, plus a reasonable profit for having created the enterprise. That position I am taking in the Buffalo reorganization. I don't know if we are going to get the State Commission to see it that way, but I believe we are. If that Commission acquiesces in that position the same as the Wisconsin State Railroad Commission has, it means one step further towards an equitable adjustment between the corporations and the public.

Now, the creation of those public enterprises in our cities such as subways, and tunnels, etc., it is pretty evident to me that these properties can be best created—not necessarily best created, but probably can be created the cheapest, upon the municipal credit, that is, upon some financial basis, which causes the city to get behind the created enterprise, even by lending its credit or by guaranteeing the bonds or even issuing city bonds upon it or issuing bonds upon the property backed by the city in some way. Mind you, I do not say that the municipality should operate that tunnel or subway, but I say you can create the property first cheaper upon city credit than upon individual or corporation credit, because a municipality can usually borrow money at a lower rate of interest than a private individual can, say half of one per cent, or some per cent lower. If it could borrow it as low as an individual can you can create the property as cheaply as the individual or corporation; if it can borrow the money at a lower rate than the individual you create the property for less—not create it for less but carry it on for less, because your fixed charges are less. To give service to the public for the least money, you want to get the benefit of the lowest fixed charges. That I believe can be done upon municipal credit better than by private credit. That is assuming, of course, that the money is honestly and properly spent by the municipality or by somebody for the municipality. That is the case also in creating a private enterprise, but the question of whether it is to be operated by the municipality or the private corporation is an entirely different thing, and I say you may lose all you have saved in the municipally created subway by improper municipal operation. I don't need to argue that question. You have got to operate a municipally owned public utility just as honestly as a privately owned one, or you lose all the advantages of the municipal credit behind it.

COMMENTS ON SHOW WINDOW LIGHTING.[1]

BY EDW. Y. PORTER.

Show window lighting may be divided into two general classes according to the kind of advertising desired, for it must be remembered that show windows and everything pertaining to them are primarily for advertising purposes.

The first class may be termed "spectacular lighting," the object being to draw attention to the window and store by means of the brilliancy, or novelty of the lighting effect as such, without special reference to the merchandise which may be displayed in the window.

The second class which we will call "merchandise display lighting" lays emphasis upon the goods displayed in the window, keeping the light sources concealed, or at least inconspicuous.

Spectacular show window lighting unquestionably has its place, but unfortunately it is all too often used, or misused, where it is decidedly out of place. Generally speaking, it is only permissible in the cheaper grade of stores and in small, shallow windows, or where a miscellaneous assortment of merchandise is dressed high in back of the window. Curio, Indian goods, novelty and toy stores may properly use exposed display lighting, provided always that the lights are of moderate candle power, and preferably frosted or enclosed in diffusing shades. The practice of hanging high power bare lamps, especially the 100 and 500 watt tungstens, in the middle of a window full of goods, is absolutely indefensible from any point of view; indeed it may properly be termed criminal, and should be prohibited by ordinance.

In large, high windows, a combination of spectacular and display lighting may be used which has some excellent features. If the plate glass is carried nearly to the ceiling line, a row of 25 or 40 watt tungsten lamps set 8 or 9 inches apart, pointing towards the rear lower corner of the window and equipped with prismatic glass reflectors, will give excellent illumination and at the same time afford a pleasing attraction in themselves, especially if there are a number of such windows in succession so that the light forms a long, unbroken line. From a distance such an arrangement will draw attention to the store, while upon nearer approach the height of the lights above the sidewalk renders them unobtrusive to the observer looking at the display of goods in the window.

The second class includes by far the greater part of properly lighted show windows. It may be laid down as a general fundamental rule of good window lighting that the flux of light should, as nearly as practicable follow the line of vision, and that the light sources should be entirely out of the line of vision and so placed that the direct rays cannot strike the eyes of the observer while he is looking at the goods displayed in the window. The following of these rules usually requires that the lamps should be located along the upper front corner of the window. Preferably the lamps should be concealed behind woodwork, draperies or an opaque sign with translucent lettering painted on the glass at the window top.

It is important there should be some subdued shadows; to secure which, the light should come from one general direction, but to avoid too sharp shadows it should not come from a single source or cluster. A row of lights along the front of a window fulfills this requirement, except in the case of a window forming one side of a deep entrance vestibule. If the row of lights is carried along the upper edge of that part of the window facing the vestibule there will be cross lighting from two directions which may obliterate the shadows, and also most of the lamps will be exposed to view from the street. Both of these defects may be corrected by bunching the lights near the front corner, and using concentrating reflectors to throw the light down and back upon the goods in the rear part of the window.

Where the entrance vestibule is very deep as has recently become popular, the scheme mentioned above is impracticable, and proper light becomes a rather vexing problem, with several possible though not entirely satisfactory solutions.

One method would be to use lamps in deep opaque reflectors, preferably of the silvered mirror type. The objections are the unsightliness of the reflectors themselves, and that the ceiling of the window would be insufficiently lighted unless it were white or very light in color, in which case there would probably be sufficient reflection from the lower part of the window for ceiling illumination.

Lamps are sometimes set in pockets in the ceiling. This method if properly designed and carried out with suitable reflectors may be made to give excellent results, and from an artistic standpoint is nearly ideal. Opaque silvered reflectors, which may be of plain mirror glass built into the woodwork, should be used, and the pockets should be of such depth that the filaments of the lamps will not be visible at more than an angle of 45 degrees from the vertical. The above construction is expensive but would be fully warranted in a high-class installation.

A third and very satisfactory solution is to use prismatic or opalescent reflectors of sufficient depth to conceal the lamp filaments. This will give a more cheerful effect to the window and also probably be received more cheerfully by the proprietor on account of the smaller expense.

One of the most difficult windows to light with any degree of satisfaction is the high and wide but shallow windows frequently found along the side street frontage of clothing stores, especially if the windows are provided with a shelf.

Such windows usually have on display men's suits which, being dark in color, require a high intensity of illumination. Also they must necessarily be displayed in an upright position, and the suits nearest the front of the window are subject to the closest inspection and should have the highest degree of illumination, yet with the usual arrangement of lights there is practically no illumination except upon the upper surfaces.

The writer is of the opinion that the simplest and best method of treating such a condition is to put high powered lamps with weather proof fittings and reflectors entirely outside of the show windows. Some light will doubtless be lost by partial reflection from the surface of the plate glass, but the light will fall upon the

[1]Presented before the Los Angeles Section of the A. I. E. E. Jan. 23, 1912.

front of the merchandise as it should, instead of upon the top only. Care must be taken that the image of the lights reflected from the glass does not come within the line of vision of an observer.

The question of intensity of illumination is an open one. Within limits it is largely a matter of the condition of the merchant's exchequer or his desire to outdo or undo his neighbor.

Before the advent of the tungsten lamp few windows could be found in which the illumination at the front part of the window floor exceeded three or four lumens per ft. (i.e. ft.-candles), but within a year the standard had nearly trebled, so that at the present time a window with less than five lumens per sq. ft. can hardly claim adequate illumination for any but the lightest colored goods. Dark goods require upwards of ten lumens for good illumination, and in extreme cases, windows have been flooded with over one hundred lumens per sq. ft. Such extreme brilliancy is poor engineering because it is wasteful. The normal human eye is a very poor judge of the intensity of illumination for intensities much in excess of that under which the object viewed can be clearly and easily seen. For example, if a piece of silk can be clearly seen without special effort under an illumination of five lumens per sq. ft. an intensity of ten lumens would add but little, if any, to the attractiveness of the goods, and if the illumination were gradually raised from ten to twenty or more lumens probably not one person in a hundred would notice the change, though some might find it difficult to see clearly with the higher intensity due to the glare of the reflected light.

It goes almost without saying that the proper intensity is governed very largely by the color of the goods displayed. An intensity which would brilliantly illuminate a window full of light colored silks or table linens, would be entirely inadequate for a display of men's winter clothing or dark dress goods, therefore provision should always be made for using part or all of the lighting equipment of a window, and the equipment for maximum illumination should be proportioned to give clear vision for the darkest goods to be displayed in the window.

The choice of lamps, reflectors and fittings is a difficult matter to discuss in a meeting of this nature on account of the commercial aspect which such a discussion naturally assumes.

Among electric lamps the tungsten or Mazda has a practical monopoly of the field for show window lighting and properly so. For spectacular lighting the smaller units, 25 or 40 watts, will naturally be used, and in some cases with low voltage, 5 or 10 watt lamps may be used. Where lamps are partially or wholly concealed, economy will usually require the use of 60 or 100 watt lamps, and in very large windows or where extremely high intensities are sought the 400 or 500 watt units might be used to advantage.

Tubular lamps with tungsten filaments, as now made, labor under the disadvantage of being low voltage lamps and therefore requiring transformers or series connection. They have special advantages for showcase lighting and in low windows or to supplement general lighting in large or special windows. Windows having approximately the same depth as height, even though quite large, may be lighted by these lamps, but for high and comparatively shallow windows the distribution of light from them as ordinarily made, is too broad and does not carry far enough to reach the lower front part of the window where the light is most needed. This, however, is more dependent upon the reflector trough in which the lamps are mounted than upon the lamps themselves, and there is no vital reason why reflectors cannot be made for these lamps which will concentrate the light in any given direction even more accurately than can be done with the reflectors used on the ordinary bulb lamps.

Reflectors are the means by which the engineer is enabled to direct and control the light from his lamps, and special care should be used in selecting those best adapted to the particular installation in hand.

Considered as reflectors only, silvered glass is undoubtedly the most efficient, and reflectors of this material, either in one piece or built up of minor sheets, may be obtained in a variety of forms and sizes. Some of these are quite pleasing in appearance, but for the most part such reflectors are best suited for concealed lighting

For exposed lighting there are many forms of prismatic and opalescent reflectors available which are fairly good reflectors and also of pleasing appearance.

Nearly all progressive manufacturers of reflectors will furnish authoritative polar diagrams showing the distribution of light at various angles from their reflectors when used with the lamps for which they were designed. Such diagrams enable one to select a reflector suited to the particular case in hand. In making such selection it should be borne in mind that it is the goods near the front of the window which are subject to the closest scrutiny and therefore require the greatest intensity of illumination.

DISCUSSION ON SHOW WINDOW LIGHTING.

BY FREDERICK S. MILLS.

In the subject of proper show window lighting there is only one class which is figured from an engineering standpoint and not from a selling point of view, with the following peculiarities derived from the details taken into consideration: Height of the windows from floor to ceiling; length from riser to riser, or divisions in the plate glass windows; depth and color of finish of the wood work; the grades or color of materials to be displayed. With these factors determined the next step is to ascertain the proper number of foot-candles and power necessary to light the windows with the greatest efficiency. A foot-candle is a normal illumination produced by one unit of candle power at a distance of one foot and equals 10.764 meter candles.

Proper window lighting is always considered the most valuable asset of a merchant and, inasmuch as the expense of installing the wood work and back-ground with inlaid floors, is comparatively great, this precaution of selecting a lighting system should also be used in recommending the proper system of window lighting and number of foot-candles to be given, regardless of the first cost of the installation. A merchant depends largely upon his show windows, wall and show cases for a 20 to 35 per cent return on the profits of his business, as they are his salesman. Where a merchant will not stop at an expenditure in decorating windows and putting elegant finishes on the interior, why should he not be controlled by a standard on illumination?

The subject of spectacular window lighting is seldom considered from an engineering stand-point. Merchants who

are installing this system of window lighting are either unreliable firms, that is, considered as transient merchants, or they have no regard for the subject of proper illumination. The contractor installs so-called spectacular window lighting on specifications emanating from an architect's office or the merchant himself. The method of installing single units of 400 to 500 watt tungsten lamps in an 8 or 10 ft. high window, regardless of the depth or length, and also clusters of tungsten lamps, is far from securing a proper diffusion of light.

Mr. Porter states in his paper as follows:

"In large, high windows, a combination of spectacular and display lighting may be used which has some excellent features. If the plate glass is carried nearly to the ceiling line a row of 25 or 40 watt tungsten lamps, set 8 or 9 in. apart, pointing towards the rear lower corner of the window, and equipped with prismatic glass reflectors, will give excellent illumination." Here a mistake is often made by merchants in different classes of trade, in adopting the same system of lighting. Very little thought is given here for the class of material displayed and the color scheme. For instance, we must consider the amount of light reflected from the goods and background to reach a definite figuring basis.

White	material	reflects	80	per	cent	of	incident	light
Light Pink	"	"	35	"	"	"	"	"
Green	"	"	18	"	"	"	"	"
Dead Black	"	"	1	"	"	"	"	"

This explains the difference in foot-candles obtaining in the same set of show windows, where a display of white goods will give good results and a window 20 feet further along, showing a line of dark material, will seem dead. This is also shown by the following table of approximate values for proper illumination of show windows:

Show	windows	with	light goods	require	8.0	foot-candles
"	"	"	medium "	"	16.0	" "
"	"	"	dark "	"	20.0	" "

There are various ways by which to determine the power needed for these windows. The method commonly used for various installations is as follows:

$$\text{Watts required (Total)} = \frac{\text{Area (sq. ft.)} \times I}{K}$$

Where the given constant, K, is dependent largely on the color effects, using as a basis—with tungsten lamps, polished surface reflectors, light walls—a constant value for K of 5.0 we have for:

Polished reflector with dark walls, the value	4.0
Satin finish " " light " " "	4.3
" " " " dark " " "	3.4

I is the intensity in foot-candles desired.

Let us discuss the second class of properly lighted show-windows. This is mostly covered by the foregoing remarks. However, we may repeat that which Mr. Porter states, "as a general fundamental rule of good window lighting, that the flux of the light should, as nearly as practicable, follow the line of vision, and that the light sources, should be entirely out of the line of vision, and so placed that the direct rays cannot strike the eyes of the observer, while he is looking at the goods displayed in the window. Following these rules usually requires that the lamps should be located along the upper front corner of the window."

Of the tubular lamps and tungsten filament, it is stated that they are laboring under the disadvantage of being low voltage, and therefore, require transformers or series connections. This is not necessary on the new wire type of lamps. Also, it is stated that the reflectors, as mentioned with this system, are only used to concentrate the light in one direction. This also has been overcome by the designing of various classes of reflectors to be used on any respective classes of installation desired. Various manufacturers are now making all classes of reflectors to accommodate tubular lamps.

PRACTICAL ILLUMINATION.[1]

BY F. B. LEWIS.

Some years ago gas lighting was revolutionized by the advent of the Welsbach mantle, and electric lighting companies became somewhat concerned over their position in the lighting field.

The 3.5 watt carbon incandescent lamp was at that time their only defense, and owing to the low efficiency and yellowish quality of light, the gas light gained considerable ground. The tungsten and other high efficiency lamps were soon after placed upon a commercial basis and regained the vanishing prestige of the incandescent electric lamp.

The advent of these higher efficiency lamps, with their greater intensity of light—or, as it is more properly called, higher intrinsic brilliancy, with the consequent damaging effect upon the eye, together with the ever increasing demand for efficiency, are probably largely responsible for the serious consideration which the subject of illumination has received recently from a scientific standpoint.

In the days of our grandfathers when artificial light had no particular commercial value, but was only considered a convenience, the tallow candle answered their purpose. This had an intrinsic brilliancy (which is the candle power emitted per square inch of projected area) of three. This form of light was superseded by the oil lamp, having an intrinsic brilliancy of six. And we find that as light sources have been improved the intrinsic brilliancy has been increased until as with the flaming arc lamp we have a light source capable of emitting 5000 c.p. per square inch of projected area.

When it is remembered that the human eye can withstand without fatigue but about 5 c.p. per square inch of surface, it is clearly seen what the harmful effect of unshaded modern light sources might be, and the question of eye protection therefore becomes one of great importance.

Table of Intrinsic Brilliancy.

Candle	3
Oil lamp	6
Gas flame	7
Welsbach gas mantle	35
Enclosed A.C. arc lamp	125
Enclosed D.C. arc lamp	150
Carbon incandescent lamp	375
Gem incandescent lamp	625
Tungsten incandescent lamp	1000
Flaming arc lamp	5000
Sun at zenith	600,000

In the table shown, it is noted that the tungsten incandescent lamp has an intrinsic brilliancy of 1000, and as this is the outcome of the ever increasing demand for light, the lighting companies soon found that unless the subject of illumination was given some attention by them, considerable harm rather than benefit would result.

By way of explanation, it might be well to point out that lighting consumers have an extremely vague idea of the kw. or unit by which they are charged for the service they receive; and, therefore, are inclined to demand light rather than the energy that produces it. It is, therefore, evident that poor efficiency, or poorly designed installations, reflect upon the lighting company, and as is usually the case, they are compelled

[1]Presented before the Los Angeles Section of the A. I. E. E., Jan. 23, 1912.

to point out to the consumer wherein the fault lies. It may be that the fault is due to dark colors of walls, or hangings, or the use of frosted globes, or the use of improper style of shades or reflectors. These points will be touched upon later.

The increasing demand for light has brought about a demand for greater efficiency in order that the expense of this increase of light shall not be prohibitive.

Light can be controlled, directed or re-directed, similar to most other forms of energy. Light rays travel in straight lines unless absorbed or deflected. Deflection can occur in one of two ways; either by refraction or by reflection. Refraction simply means the bending the light ray, as, for instance—when a light ray strikes a pane of glass at a certain angle its direction is slightly changed in its passage through the glass.

Reflection may be either regular or irregular. Regular reflection occurs when light strikes a smooth surface, such as a mirror, and is reflected as a sharp beam. The angle at which it strikes the mirror being equal to the angle at which it is reflected.

When, however, light strikes a rough surface, whether polished or unpolished, the light is reflected in all directions, causing what is called, irregular or diffused reflection. This, in the case of a piece of glazed writing paper resting on the desk, we often find a glare from the paper, which is caused by the concentrated reflection; but if this glazed paper be replaced with blotting paper, the glare will disappear, due to the rough surface of the latter, and the resulting diffused reflection.

Different colors absorb or reflect different percentages of the light, and it is for this reason that a room which is papered with a dark color has the appearance of being poorly lighted, whereas the same candle power of lamps, by simply changing the wall paper for a light shade, will make the room appear much brighter.

	Per cent.
Mirror reflects	95
White paper	82
Yellow	40
Pink	36
Blue	25
Green	18
Dark brown	13
Red	12
Black paper	0.5
Deep chocolate	0.46
Black velvet	0.4

In the same way, tapestry, burlap and velvet absorb a great quantity of the light. The smoother the surface the more will be the light reflected, as for instance, a tinted wall will reflect more than a wall covered with wall paper. Glass also absorbs light.

	Per cent.
Clear glass absorbs	10
Frosted glass absorbs	30-45
Opal glass absorbs	40-50
Alabaster glass absorbs	50-60

Intensity of light is expressed in candle power, which is simply an expression in terms of light given by a standard candle. To measure the candle power of a light source a screen is placed between this light source and a standard candle, or a lamp that has previously been standardized by the candle, and it is moved to a position that obtains equal brightness on both sides of the screen. The intensity varies inversely as the square of the distance of the light sources from the screen; as, for instance, if the standard candle measures one foot from the screen and the lamp to be tested measures four feet, its candle power will be four squared or sixteen. In this way it is also possible to determine the candle power which a lamp gives in each direction, in other words; determine its photometric curve.

It is thus found that all ordinary incandescent lamps give the most light in a direction at right angles to the length of the lamp. In fact, while the common 16 c.p. lamp gives 16 c.p. in this direction, it gives but 6.6 c.p. at the tip, the direction in which the light is most needed when the lamp is hanging vertical, as is usually the case. It is evident, then, that a bare lamp like this hung in a room, will throw the maximum amount of light on the walls of the room, and only 40 per cent of this amount of light down, where, in nearly every case it is most needed. This readily illustrates the necessity of using reflectors to change or redirect the rays of light as given off by the lamps, and reflect them where they are of the most use.

If this same lamp be equipped with a concentrating prismatic reflector, such as the Focusing Holophane, the candlepower in the horizontal direction will be 7, and in the downward or vertical direction, 57. This reflector is suited to all locations where concentrated light is desired at one point, without distribution over a wide area; for instance, in show windows or in halls or very small rooms having high ceilings.

Other types and designs of reflectors control the light in a similar manner, but redirect it through wider or narrower angles, and it is necessary to know the area that is to be lighted, and the height above the floor that the lamp may be hung before the proper selection of a reflector can be made.

Effective illumination is usually that part which is directed downward and not to exceed 60 degrees from the vertical. As an example, a bare 60 watt tungsten lamp will furnish a flux of light in a direction between 0 degrees and 60 degrees from the vertical of 86.8 lumens. This same lamp equipped with an intensive reflector will furnish 221 lumens, or a gain in effective illumination by the use of the reflector of 155 per cent.

The size and number of lamps or total candle power required depend upon three things: First, the intensity of light required for the room to be lighted; the type of reflectors to be used, and the color of the walls and ceiling of the room. One is no less important than the others. Intensity of light has for its unit the foot-candle, or the illumination produced on a surface one foot distant from a light source of one candle power. Since light varies inversely as the square of the distance, a 16 c.p. lamp will give an illumination of one foot-candle on a surface four feet from the lamp. The foot-candle intensity required to give satisfactory results depends upon the class of service and varies from 0.1, for the residence street lighting, to 20.0 for show windows. Again, stores and show windows on an active business street in a large city must have higher illumination than in small towns where there is less competition or rivalry in display lighting. With indirect or

concealed lighting, and with direct lighting from extremely high ceilings, higher intensities must be allowed than with direct lighting from usual ceiling heights.

In the past, and largely at the present time, the designing of lighting schemes has been handled solely by the architect, but on account of the increasing importance of this phase of engineering, it is becoming recognized as a profession. However, it is so closely affiliated with the architecture, that it should be handled jointly.

THE BURNING OF POLE TOPS.

The Washington Water Power Company has encountered a peculiar trouble in the burning of pole tops. Upon testing the insulators from these burned poles no punctures are revealed and the only solution to be suggested is that the heat from the charging current has started a smoldering fire in the poles and grounding of the pins has been resorted to. Whether or not this will prove to be the desired remedy time only can tell as no similar work has been done heretofore.

JEWEL BEARING FOR ELECTRIC METERS.

Cup diamond jewels are being used by the Seattle Electric Company in all large direct current meters and in some of the small direct current meters working on a high-load factor. The results have been highly satisfactory, the life being about five times the life of the sapphire jewel. Owing to dissatisfaction with the results obtained with sapphire jewels in induction meters, the company last year purchased 1400 induction meters with diamond jewels. However, they have not been in service a sufficient length of time to determine what length of life can be expected of them. The flat diamond with a ring-stone sapphire guide has not proven satisfactory.

THE USE OF LIGHTNING ARRESTERS AROUND PUGET SOUND.

In the Puget Sound territory lightning arresters do not ordinarily function in accordance with their name. Lightning is exceedingly rare as shown by a report of the Seattle Electric Company. With but two interruptions due to lightning in over seven years and with damages on each occasion not exceeding $15, it may be wondered for what purpose these appliances are used. They serve to take care of surges set up by switching, short circuits, grounds and other disturbing elements occurring in lines of 13,000 volts. There are several types in use, the most efficient probably being the aluminum cell arrester.

One of these, placed on the bus of a 13,800 volt system, has discharge with each disturbance set up in spite of the arrangement wherein the surge had to pass back through current transformers and a set of choke coils in the lines. This is a very good record considering that the protection afforded by arresters on a bus is held to be rather doubtful due to the large inductance offered to high frequency surges by the current transformers on each line.

AN IMPORTANT LEGAL OPINION.

Of utmost importance to public service corporations throughout the State of California is the recent legal opinion of John W. Shenk in brief presented to the Los Angeles Council referring to the effect of the repeal of Section 19 of Article 11 of the constitution of the State of California. The matter is entirely self explanatory and is published in full below:

Section 1. From the time of the adoption of the California constitution of 1879 until October 10, 1911, the constitution of the State of California contained the following provision in Section 19 of Article XI:

"In any city where there are no public works owned and controlled by the municipality for supplying the same with water or artificial light, any individual, or any company duly incorporated for such purpose, under and by authority of the laws of this State, shall under the direction of the superintendent of streets, or other officer in control thereof, and under such general regulations as the municipality may prescribe, for damages and indemnity for damages, have the privilege of using the public streets and thoroughfares thereof, and of laying down pipes and conduits therein, and connections therewith, so far as may be necessary for introducing into and supplying such city and its inhabitants either with gaslight, or other illuminating light, or with fresh water for domestic and all other purposes, upon the condition that the municipal government shall have the right to regulate the charges thereof."

The purpose of the foregoing section of the constitution, as disclosed by the record at the time of its submission to a vote of the people, was to permit free and open competition between persons and corporations desiring to engage in the business of furnishing water or artificial light in municipalities and to prevent a monopoly in the furnishing of these utilities. The effect of the adoption of the section was to permit any person or corporation desiring to engage in such business to occupy the public streets of municipalities without obtaining franchises from the city authorities and without hindrance or restriction on the part of local authorities other than that necessary in the proper exercise of the police power. Under that section many companies have been organized and are now furnishing water, gas or electric light to the City of Los Angeles and its inhabitants and occupying and using the public streets of the city for that purpose. The courts, both State and federal, have held that the foregoing section of the constitution was an offer of a franchise, and when accepted by persons or corporations [illegible] falling within its provisions [illegible] rights [illegible] between such persons or corporations and the State which were vested and protected by the federal constitution.

On October 10, 1911, the section of the constitution [illegible] referred to was amended to read as follows: "[illegible] municipal corporation may establish and [illegible] public works for supplying its inhabitants with light, [illegible], power, heat, transportation, telephone service [illegible] means of communication. Such works may be acquired by original construction or by the purchase of existing works, including their franchises,

or both. Persons or corporations may establish and operate works for supplying the inhabitants with such services upon such conditions and under such regulations as the municipality may prescribe under its organic law, on condition that the municipal government shall have the right to regulate the charges thereof. A municipal corporation may furnish such services to inhabitants outside its boundaries; provided that it shall not furnish any service to the inhabitants of any other municipality owning or operating works supplying the same service to such inhabitants, without the consent of such other municipality, expressed by ordinance."

By the adoption of this amendment the policy of the State with reference to the control of public service corporations as distinguished from the policy declared by the old section was radically changed. Under the old section any person or company organized for the purpose could occupy the streets of the city without obtaining the consent of the city for the purpose of introducing and supplying to the city and its inhabitants water for domestic purposes, gaslight and other illuminating light. The city has no voice in the occupation and use of its streets for such purposes other than as might fall within the exercise of the police power. The exercise of the police power, however, did not interfere with any substantial right acquired by those who had availed themselves of the provisions of the section. Those rights had become vested and were protected not only by the constitution of the State but by the constitution of the United States. It is true, however, that such rights vested only in behalf of those who had actually availed themselves of the offer extended by the old section and did not inure to those who might, after the amendment, desire to engage in such business. All persons and corporations, therefore, who had not accepted and acted upon the provisions of the old section and who desire to establish and operate works and plants for the purposes enumerated in the old section must obtain permission from the city and establish and operate such works and supply such service only upon such conditions and under such regulations as the city may prescribe under its organic law.

Another and more important question, however, is presented, namely: Has a corporation that has established a system for supplying the city and its inhabitants with fresh water, gas or electric light and occupied certain streets of the city for that purpose prior to the amendment of October 10, 1911, acquired the right under the old section of the constitution to use all the streets of the city, regardless of time, growth of expansion of the city, which were not occupied by such corporations at the time of the amendment.

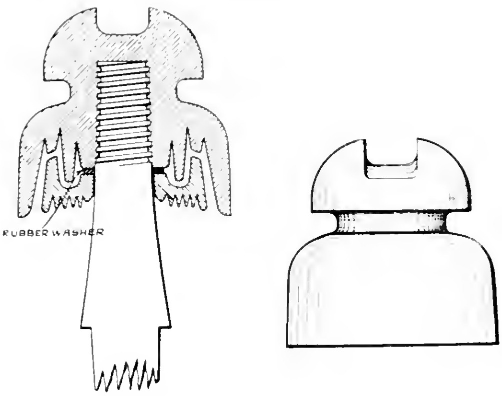
The right acquired under the constitution prior to the amendment by the actual acceptance of its terms constitutes a franchise which is in the nature of an easement in and pertaining to the streets in which the right is exercised. It is inseparably annexed to the streets in the city in and upon which it is exercised and does not, in my opinion, extend further than or beyond the streets actually occupied for the purpose at the time of the amendment. No rights were acquired except in so far as the provisions of the constitution had been accepted, and it is competent for the State at any time to withdraw the offer extended by the section as in force prior to the amendment. A withdrawal of the offer was, in my opinion, accomplished by the amendment which went into effect October 10, 1911. The history of the City of Los Angeles, especially within recent years, evidences a great territorial expansion and a corresponding increase in mileage of streets. A like expansion and increase will undoubtedly take place in the future. In my judgment it can not be successfully contended that the mere establishment of a works or plant and a distributing system in connection therewith vested in the grantee the right for all future time to use all of the streets of the city not occupied on October 10, 1911, or that the scope of the right acquired was measured by the terms of the offer and not by the extent to which it had been accepted. If any serious doubt might exist as to the rights in this connection of the utility corporations under the amended section those doubts under a familiar rule of construction would, in my opinion, be resolved most strongly against the corporations and in favor of the public. My conclusion is that the corporations acquired rights under the old section only in the streets of the city which were actually occupied and used at the time of the amendment and that as to streets not so occupied and desired for use by the utility corporations the consent of the city must be applied for and obtained in accordance with the provisions of the section as amended.

How then is the city to grant the right to the utility corporations to use the streets which were unoccupied prior to the amendment? The amendment to the constitution provides that persons or corporations may establish and operate such works and supply such service upon such conditions and under such regulations as the municipality may prescribe under its organic law. The charter of the City of Los Angeles is its organic law. Subdivision 40, Section 3 of Article 1 of the charter provides that no franchise, right or privilege, in, on, through, across, under or over any streets or other public place, and no other franchise what ever granted by the city to any corporation, association or individual shall be granted except by an ordinance passed by a vote of two-thirds of the whole council nor for a longer period than twenty-one years, etc. Subdivision 46 of the same section provides that the city shall have the right and power to grant franchises or privileges in, on, through, across, under or over any street or other public place and to prescribe the terms and conditions of any such grant and to prescribe by ordinance the method of procedure for making such grants, subject to the limitations elsewhere contained in the charter. The matter of granting rights and privileges in the streets for the purposes, among others, of laying pipes and conduits and erecting poles and wires on the streets is therefore under the law a matter of regulation in accordance with the provisions of the charter. In conformity with the amendment to the constitution and the charter provisions above referred to, the city has by ordinance prescribed a method of extending water mains, gas mains and electric light lines in streets which were not actually occupied and used at the time of the amendment to the constitution. An application for the privilege so to do should be filed and a franchise therefore granted

in accordance with the charter and the ordinances of the city prescribing the method of procedure in the premises. I recommend that the Board of Public Works be instructed to issue no more permits for the laying of water mains, gas mains, or the erection of electric light poles and wires in streets not actually occupied by the utility corporations for the respective purposes contemplated by the constitution prior to the amendment unless the applicant therefore has a franchise duly granted for that purpose. And I further recommend that the utility corporations affected be notified by the clerk that franchises for said purposes should be obtained in accordance with the charter and ordinances of the city.

BETTER INSULATION.

From the first days of the telegraph, more than sixty years ago, it has been the aim of the transmission companies to find an insulator that would remain an insulator in good weather and in bad. Up to the present time it has been the expectation that during a drizzle or a fog, the wire facilities would be materially lessened owing to leakage and the cross-fire that takes place on every crossarm.



Type of Insulator Used in Test

Now comes the "Noleak" insulator, in which the under part, that is the petticoats, and the space between the petticoats, is protected from dust and moisture. A dry clean space is always present between the conductor and the pin. This effectively stops the leakage that must always obtain with the ordinary insulator when it becomes dirty.

About two years ago the Journal made mention of this new insulator, and in view of the importance of improved insulation it now takes pleasure in giving the results of a test of twenty-eight months on 71 miles of line through a fog belt along the coast of Southern California.

After five months use the following report was made:

"The difference in the actual working of the two wires was very noticeable. No. 2 was very heavy and San Diego had difficulty in adjusting, while No. 1 (equipped with "Noleak" insulators) was clear and could have been worked at high speed."

After seventeen months' use the conditions were stated thus:

"Since the installation of the "Noleak" insulators there has been a great improvement in the working of the two wires. The cross-leak has been reduced to a point where it does not trouble us, and the two wires have been simultaneously workable. Normally the wire insulated with the "Noleak" insulator shows from one-fifth to one-half the escape of the other wire. The elimination of the cross-leak, however, is the best achievement of three insulators, and I believe it is only fair to give them full credit, as the cross-leak has certainly been eliminated since the "Noleak" insulators were put on."

After twenty-eight months' service this statement was given:

"The conditions are practically the same as when I wrote you a year ago."

The chief object sought for by the designer of this insulator, L. W. Storror, who has been prominently identified with the telegraph and telephone service on the Pacific Coast for many years, was to overcome the leakage and cross-fire which threw the greater portion of the lines in the fog belts out of commission every time there was a fog or a drizzle. How successfully this object has been accomplished is shown by the foregoing records.

A more recent series of tests, extending over a period of six months, has just been made. In July, 1911, one pair of aerial wires across Goat Island was equipped with new standard D.P. Insulators, and another pair of wires was equipped with Noleak Insulators. Tests have been made twice a day on seventy-nine days since October 20th, 1911. The lowest measurements of each wire, taken at the same time, indicate that the Noleak Insulator has one hundred and eighty-four per cent greater efficiency than the standard D.P. Insulator.

With this will be found a sketch of the latest pattern of the Noleak Insulator. Eight and one-half inches of insulating surface intervenes between the line wire and the pin, and it is claimed that one-half of this distance will always remain clean and dry.

Insulation experts have declared that sixteen per cent increased distance between line and pin means 100 per cent greater efficiency. The new form of insulator has 25 per cent more insulating distance than the form upon which the tests were made.

MARKET FOR POWER MACHINERY.

There are 2630 industrial establishments in Chile using power machinery aggregating 58,895 horsepower, as follows: 932 steam engines, with 25,312 horsepower, 388 gas engines, with 8494 horsepower; 285 hydraulic engines, with 13,847 horsepower; 112 petroleum engines, with 1332 horsepower, and 922 electric motors, with 9910 horsepower.

It will be seen that here is a field worthy of the attention of builders of power machinery. The tendency is toward hydroelectric machinery and gas and petroleum engines. To date, the greater portion of the power machinery has been supplied by England and Germany, with Germany in the lead. The United States has been gaining some, but there is still a big margin before American interests are getting what would seem a fair portion of the business. Machinery enters free of duty.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Great Circle

In the study of elementary geometry we find that a straight line is the shortest distance between two points. Again in the study of solid geometry, the shortest distance between two points upon the surface of a sphere is along the perimeter of a great circle passing through these two points. A great circle is cut out by the surface of a sphere when a plane passes through these two points and the center of the sphere. This law brings about many interesting illusions as to the shortest distance when these two points are two different geographical centers on the surface of the earth. Thus, when a boat sails from one point to another, at first glance we would say that it is heading for the wrong point by compass to gain its ultimate haven, and yet when we come to study the conditions more closely, we find the old sea-captain knows his geography and knows it well, and his good ship is following its journey along the perimeter of a great circle connecting the port he has just left and the port to which he desires to arrive in the shortest time possible. If now we consider the map of the world represented on one of the well known geographer's globes some interesting deductions are at once brought to our gaze. By a careful glance at the map it is seen that the great circle between the Panama Canal and the Orient comes within a few miles of the Coast of California, and hence it is but reasonable to believe that her harbors will be ship-laden from every port in the world.

Transmission Line Design

The leading article of this issue is by Otto Falch on the Design of the Stanislaus Transmission Line. This installation is owned by the Sierra & San Francisco Power Company and transmits into San Francisco power developed on the Stanislaus River, 134 miles away.

The installation of steel towers in the modern hydroelectric transmission plant seems now to have become firmly established. Indeed no longer are the more enterprising power companies contenting themselves with one steel tower transmission line, but now we find the Pacific Light & Power Corporation of Los Angeles proposes to install at once a double steel tower transmission line, 275 miles long, in transmitting power from Big Creek into Los Angeles at 110,000 volts. Each steel tower line is to have two complete sets of wires for three-phase transmission and the twelve wires thus installed will unquestionably be the most pliable in long distance transmission in the world.

In his paper, Mr. Falch shows that the small saving of 100 pounds of steel per tower meant a saving to his company of $10,000. It is then easy to see to what extent careful design is remunerative.

The method of spacing steel towers outlined is both simple and instructive. It illustrates at a glance the ease with which one can properly space transmis-

sion towers after a careful profile of the line has been plotted. At first thought, the use of the standard catenary impresses one with the idea that this would not allow sufficient pliability to the system. Throughout this entire installation, however, the remarkable feature of design is the constant adherence to standard forms. Even in the crossing of San Francisco Bay wherein the most suitable and careful design was considered from every point of view, no deviation has been made from the standard design, although at this point additional height was necessary.

Closely adhering to standard form, the two portions of the towers are of the same make up and dimensions. Quick repairing in event of emergency is thus assured.

In our next issue will be found the beginning of a series of articles on the Elements of Steam Turbine Operation and Design.

A Gigantic Steam Turbine

Steam turbine installation has during recent years become of highest economy in auxiliary power plant operation.

The advent of practically an unlimited supply of cheap fuel, due to the California oil fields, amounting to a production of nearly eighty million barrels a year, caused many serious minded engineers to speculate as to whether hydroelectric enterprises would not become more costly in operation than the steam generating power plants. The try-out over several years has resulted, however, in the firm establishment of the hydroelectric plant. Nevertheless, the great central stations of the Coast are finding it imperative to their needs to have steam auxiliary apparatus which can be thrown into complete generating synchronism at a moment's notice.

Unlooked for demands for immediate power consumption, and continuity of service seem to be completely met with the rapid advance of the steam turbine. Hence it is that we find up and down the Coast, situated in the great centers of power consumption, enormous steam auxiliary plants kept in the prime of condition, ready at the first ring of the despatcher's phone, to assist their hydroelectric brothers in carrying their burdens should the occasion arise.

Los Angeles, Oakland, San Francisco, Portland Seattle and Spokane all seem to have felt the need for this design of auxiliary apparatus. It is interesting to note to what gigantic proportions they have grown almost in the moment. But a few years ago a group of reciprocating units of say 2500 h.p. was the wonder and admiration of all observers. Today, however, the small and modest turbine is seen in the modern power plant occupying a space almost inconceivable for its smallness in comparison to the formerly installed reciprocating units. As one enters the generating station where reciprocating units are still maintained and also some of the more recent design of turbine is installed, the contrast between the two is the striking feature. Row after row of reciprocating units, grinding out their mournful supply of energy, is a forceful opposite to the trim, even, and non-obtrusive appearance of their sister unit, the steam turbine.

This even uniform appearance of the turbine is most strikingly borne out in its operation. Steadiness and continuity of service is the cry of the operating manager. The ease with which such enormous concentrated energies are put forth, when desired, has won for the turbine a unique position in the modern power plant.

Most impressive is this gigantic concentration of energy generation. Within the last few days the Pacific Gas & Electric Company of Central California has installed and put into operation the largest steam turbine on the Pacific Coast. The turbine is located at Station A in San Francisco and has a rated capacity output of 15,000 kilowatts or 20,000 h.p. Such statements of power rating do not convey to the average reader the enormous energy that is being developed by this modern Titan.

Perhaps we can get a better conception of the prodigious electrical supply which is capable of being generated by this monster when we say that a string of horses, six abreast and seven miles long, working to their utmost could but equal the energy of this single, modest unpretentious, cylindrical-shaped mechanism. Indeed, could we neglect for the minute the question of line drop in the wires, this one unit would be capable of lighting a string of 16 candle power lamps placed only 220 feet apart that would encircle the globe. A great white way stretching from Yellowstone Park, through Spokane, Seattle, San Francisco, Yosemite Valley and Los Angeles with a double row of lights, 25 feet apart, could similarly be lighted. So far as power is concerned our novelty managers of the Panama-Pacific International Exposition could, by means of this turbine, generate sufficient energy to deliver a sightseer to the moon and back every three minutes.

For years the advance of the steam turbine was hindered, due to the fact that, for maximum efficiency, speeds approximating 25 miles a minute were necessary. The modern inventor has, however, overcome this difficulty. The steam within the turbine cylinder is now expanded through several stages, six in the case of the turbine above referred to, and the consequence is, that maximum efficiency is obtained at far lower speeds.

It is interesting to note, that if an observer were perched upon one of the tiny buckets in the periphery of this present monster turbine, he would pass through a distance of some six miles a minute and could be hang on for three days he would outdo Nellie Bly in her classic foreign visitations, for in this brief time he would travel a distance equal to a trip around the whole world.

Such concentrated powers are for the human mind almost unconceivable. To this massing of energy generating mechanisms, nevertheless, unquestionably points in approval the index finger of modern power plant economy.

PERSONALS.

W. D. Thomas, an electrical contractor of Petaluma, was a recent San Francisco visitor.

J. W. Ricketts, electrical engineer at Chico, Cal., was in San Francisco during the past week.

C. L. Cory, electrical engineer, has returned to his San Francisco office from Los Angeles.

R. F. Chevalier, consulting engineer of San Francisco, has spent the past week in Portland, Oregon.

Thomas Mirk, of Hunt, Mirk & Co., has been visiting Los Angeles and San Diego on engineering business.

Leon M. Hall is engineer for the Mono Power Company and other projects financed by the Adams interests.

Harry Hays, purchasing agent of the Mt. Whitney Power Company, is among the recent arrivals at San Francisco.

Frank H. Ray, of New York, who is interested in the Great Western Power Company, is a San Francisco visitor.

C. T. Phillips, illuminating engineer, has returned to San Francisco after a business trip through the interior of the State.

J. J. Davis, vice-president of the Santa Monica Light & Power Company, is among the recent arrivals at San Francisco.

Charles Froding, agent for the Foster superheater and a garbage destructor, is in Arizona superintending a new installation.

A. M. Hunt, who is touring Egypt, was on the Upper Nile when last heard from. He will remain abroad for several months longer.

John S. Baker, district manager of the Crocker-Wheeler Company, has returned to his San Francisco office after spending a week at Los Angeles.

H. Wolfe, who was formerly connected with the Levy Electric Company, has joined the sales force of the California Electrical Construction Company.

C. E. Patton, Pacific Coast manager for the Central Electric Company of Chicago, passed through San Francisco during the past week on his way North.

O. G. Steele, superintendent of the Siskiyou Electric Power and Light Company, with headquarters at Eureka, spent the past week at San Francisco.

G. C. Holberton, manager of the San Francisco District, of the Pacific Gas & Electric Company, recently visited Grass Valley, Nevada City and surrounding territory.

Charles C. Hillis, manager of the San Francisco house of the Electric Appliance Company, is on his way East and will spend about two weeks in visiting the factories at Cleveland and elsewhere.

Edson F. Adams has returned to Oakland after spending a month in the East and it is expected that the work on several hyydroelectric developments, in which he is interested, will go forward rapidly.

B. B. Beckett has been appointed manager of Pierson, Roeding & Co.'s office at Seattle, in place of R. H. Husbands, resigned. Beckett was formerly chief engineer of the firm with headquarters at the San Francisco office.

F. G. Baum, who has been the partner of W. P. Hammon in the ownership of the electric power and traction system at Monterey and Salinas, which is reported to have changed hands again, has returned to San Francisco from Monterey.

H. E. Adams, who has been manager of the Western States Gas and Electric Company's interests, with headquarters at Stockton, since H. M. Byllesby & Co. entered California, has resigned and has been succeeded by W. S. Butler, who has assumed general control.

A. E. Barlow, who is now general sales manager of the American Ever Ready Company on the Pacific Coast, is making a business trip through the Pacific Northwest.

W. E. Barrett, the gas engineer of J. G. White & Co., has returned to Los Angeles after an Eastern trip on business connected with the construction of the Midway Gas Company's pipe line for natural gas.

Sidney Sprout has returned to Siskiyou County after spending a week in San Francisco, receiving bids for a 10,000-kw. hydroelectric plant for the Siskiyou Electric Light and Power Company. The specifications call for one horizontal 10,000-kw. 3-phase 60-cycle generator and a direct-connected turbine water wheel to operate under a head of 130 feet. An independent exciter set and some transformers are also to be purchased.

P. M. Hunt, of Hunt, Mirk & Co., is at Tulare starting work on the new electric power installation of the Tulare County Power Company. The boilers are on the ground and a 1500-kw. steam turbine plant will be installed so as to transmit current at 11,000 volts over a large area of farming land surrounding Tulare. Power will be furnished for irrigation, pumping, lighting, etc. C. H. Holley, who was formerly with the Mt. Whitney Power Company, is consulting engineer and has an interest in the new company. Its water rights in the mountains will be developed.

EELECTRICAL CONTRACTORS' NOTES.

The strike that has been carried on in San Mateo for the past nine months has been settled and every one is happy again.

Secretary Hanbridge of the State Contractors' Electrical Association, reports business good in Sacramento and Stockton.

Mr. Glenn Arbrogast, Los Angeles representative of the Newberry-Benheim Company, was in San Francisco last week on business.

C. V. Schneider, manager of the Electric Supply Company of Sacramento, has been in San Francisco attending to business.

H. Reid, manager of the Pacific Extinguisher Company, has returned to San Francisco from Portland after a two weeks' business trip.

The Newberry-Benheim Company has just been awarded the wiring contract for the Stanford Memorial Church at Palo Alto, for the sum of $2900.

The Levy Electric Company was awarded the electrical work for the five story hotel at Sacramento and Drumm streets for the sum of $2200. Shea & Lofquist are the architects.

M. Jacobs, a contractor from Santa Rosa, E. Bogle, a contractor from San Rafael; F. Somers, a contractor from San Jose, were in San Francisco during the past week and attended the Development League meeting.

Wm. J. Nixon has been appointed chief of the Department of Electricity of San Francisco. Mr. Nixon was chief prior to the old administration and won the confidence of the electrical people by the manner in which he attended his duties. The contractors are well pleased, as they know he will give them all a fair deal.

W. S. Hanbridge, secretary of the State Association, attended a meeting of San Jose Local No. 9 recently. Arrangements were started for an entertainment of the contractors, their families and friends for the State Convention in August. A fine time is promised and it is hoped that all of the electrical fraternity will arrange their vacations so as to be the guests of the San Jose contractors. Mr. Hanbridge reports that in the history of the organization it was never in better shape.

INDUSTRIAL

O-B LOCK HANGERS.

The Ohio Brass Company is listing several forms of round top hangers with a locking feature for giving, at all times, a tight joint between the hanger body and the boss of the trolley ear.

The locking feature is obtained by inserting a non-rotatable stud and a spring washer in a cup casting which is swaged over an anchor casting moulded into the insulation, thus anchoring the whole firmly in the outer body casting. The stud has a limited vertical movement in opposition to

O B Lock Hanger

the lock washer and therefore, it is possible to screw the trolley ear onto the stud until the top of the boss on the ear is in contact with the cup casting of the hanger and then continue rotating the ear until it is in alignment with the trolley wire. This continued rotation, after the first contact, causes the lock washer to be compressed and this condition guarantees a tight joint at all times, thus eliminating vibration between the stud and ear boss and preventing the wearing out and stripping of threads.

The hanger can be furnished with 5/8 inch stud and in two sizes of the form shown in the accompanying illustration and with a 3/4 inch stud in the form having the clips on the out-riggers turned upward.

LOS ANGELES ELECTRICAL LEAGUE.

The weekly luncheon of the Electrical League was held Thursday, January 18, in Los Angeles. For the coming year R. H. Manahan, city electrician, was elected president; H. B. Woodill, of the Woodill & Hulse Electric Company, vice-president; R. B. Clapp, of the Westinghouse Electric Manufacturing Company, secretary-treasurer; Mr. Koster of the Los Angeles Gas & Electric Corporation, director, and Mr. Childs of the Southern California Edison Company, director. Committees for the different functions will be appointed later.

TRADE NOTES.

Frank R. Wheeler, formerly San Francisco and Chicag manager of the C. H. Wheeler Manufacturing Company, an R. B. Guernsey announce their association as the firm Guernsey & Wheeler, with offices in the Rialto Building, S Francisco. They are district managers for American Blow Company, Kerr Turbine Company, Warren Webster & Co., H. Wheeler Manufacturing Company, Vacuum Engineeri Company, Uehling Instrument Company.

The Westinghouse Electric and Manufacturing Compa has sold the Oakland and Antioch Railway Company a 750-k synchronous motor-generator set which is to be installed i new sub-station on the line of the new electric road. Po will be taken from the Great Western Power Company direct current at 1200 volts will be generated for the railr A 50-ton Westinghouse electric locomotive will be deliv in the spring.

ANNOUNCEMENT BY GREAT WESTERN POWER CO.

The Great Western Power Company announces that to fill the vacancy caused by the death of Edwin Hawley, Mortimer Fleshhacker has been elected president, and A. W. Bullard, vice-president. Mr. Bullard will reside in San Francisco, and will be actively associated with Mr. Fleshhacker in the management of the company's affairs.

The company also announces that through an underwriting of securities which it had available, $2,850,000 has been provided for the extension and development of its properties. This money is immediately available and will care for the company's financial needs for more than a year.

It is expected that the Dam at Big Meadows, for impounding more than 1,000,000 acre feet of water, will be completed during the dry season of 1912. All of the preliminary work has been done this year.

The cable under the bay of San Francisco has been laid and is in successful operation and electric current from the hydroelectric plant, 175 miles from San Francisco on the North Fork of the Feather River, is being successfully delivered to the customers of the company's subsidiary, City Electric Company, in San Francisco. Very substantial savings in operating expenses accrue from the use of this hydroelectric power, and in addition, the large steam plant at the foot of Mason street is rendered available as a reserve to insure continuity of service for the company's customers both in San Francisco and across the bay.

An additional 20,000 kw. generating unit will probably be installed in the Big Bend power house on the North Fork of the Feather River during the coming summer. This will increase the capacity of that station to 60,000 kw. which is equivalent to 80,000 horsepower. The rapidly developing business of the company would seem to warrant this addition to its generating capacity.

Great confidence is felt by the management of the company in the development of the Sacramento Valley and the bay region, including San Francisco, and it is believed by them that extensive preparations must be made for the very large demands for power already in evidence and to develop in the next three or four years.

BOOK REVIEWS.

Telephony. A comprehensive and detailed exposition of the theory and practice of the telephone art. By Samuel G. McMeen and Kempster B. Miller. Size 6½x9½ inches; 918 pages; 671 illustrations; durable cloth binding. Published by American School of Correspondence of Chicago and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $4.00.

on telegraphy. The authors, the unquestioned leaders in telephone engineering of today, have put into its pages numbering nearly a thousand, the very best that there is in the art. The illustrations are clear and to the point and bear the stamp of uniformity which make the book of unusual clearness for the beginner. The reader is first taken through a preface alive with human pulsation, then into the book proper, the introduction of which touches interestingly on a brief history of the development of the art of telegraphy. From the simple laws of acoustics, the electrical reproduction of speech, he is finally step by step taken in simple thought throughout the labyrinth of intricacies involving a mechanism and its use which today numbers one for every twelve people in the United States. It is needless to go into all the hundreds of separate discussions met with in this production, suffice it to say, if you want a book on telephony you can not afford to be without this one.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Midland Counties Gas & Electric Company has been incorporated at $1,000,000, with shares at $100 each. Five hundred dollars has been subscribed by W. A. Nunlist, J. J. Welch, P. W. Webb, J. A. Williams and W. C. Crittenden.

BOISE, IDAHO.—A new power company is being organized for the purpose of making power on the Payette and Snake rivers for consumption in Boise. An engineer has been employed to make surveys and estimates of the costs of developing power at the two sites which the company has in mind. The company is to be capitalized at $1,000,000.

ILLUMINATION.

HUNTINGTON, ORE.—A franchise has been granted to the Oregon-Idaho Light & Power Company for an electric plant, which will render light, power and heating service.

BEND, ORE.—Henry Linster has petitioned the County Court for franchises for a water and electric system in Aubrey Heights, which is on the west side of the river from Bend.

SONOMA, CAL.—Messrs. Evans & Brooke of the electric light company are getting long term contracts from the consumers of the valley. This company expects to enlarge their plant and rebuild all of their lines.

PORTLAND, ORE.—Mayor Rushton is endeavoring to eliminate from Portland all storage tanks for oil, and to allow only distribution tanks in the "East Side." This would cut down the 750,000 gallon storage of the Standard Oil Company about sixty per cent.

PORTLAND, ORE.—The restraining order of the courts having been removed the Hydroelectric Company has turned its current into the lines entering Hood River. The Hood River Gas & Electric Company has begun a rate cutting war on the former company.

CORONA, CAL.—Sealed bids will be received until March 19 for the purchase of a franchise granting the right to construct and for a period of fifty years to maintain an electric pole and wire system upon all the streets, alleys and thoroughfares of the city.

PLACERVILLE, CAL.—The expenditure of $100,000 on the reconstruction of miles of flume and the employment of about 150 men for several months will be the result of preliminary work now being carried on by a corps of civil engineers for the Western States Gas & Electric Company.

GRANTS PASS, ORE.—The City Council has considered the petition signed by citizens asking for an amendment to the charter to bond the city for $400,000 for a water and light system; and after some discussion the matter was referred back to the petitioners for investigation and correction.

SANTA ROSA, CAL.—The Great Western Power Company will enter this field in active competition with the Pacific Gas & Electric Company on July 1. An application will be filed with the Supervisors for a franchise to construct lines over the county roads. It will necessarily be a blanket franchise, covering practically all the roads of the county.

FALLS CITY, ORE.—A guy wire short circuited the high tension wires from the power house and blew the transformer fuses. The governor on the water wheel stuck and the wheel ran away, wrecking the generator. When the accident happened the attendant was out of the station, shutting down flood gates at the dam. The town will be without lights for about two weeks.

OAKLAND, CAL.—The Central Oakland Company is to invade the residence districts of the city with a cut of the light rate from 7c to 6c. This is the newest move in the triangular rate war in Oakland, the three parties to which are the Central, the Great Western and the Pacific Gas & Electric. Meanwhile the Great Western Company is offering power to manufactories along the estuary. The light and power rate war started with the entry of the Central Oakland Company to the business section. Previous rates for light and power tumbled at once, first in a cut by the new company, then in a retaliatory reduction by the older corporation, the Oakland branch of the Pacific Gas & Electric Company. Nine-cent charges were reduced to 7c, and in the district where power was supplied, some services were sold as low as 1c.

LOS ANGELES, CAL.—Declaring the functions of a county board of equalization to be judiciary and not assailable in the courts unless so warranted by evidence of fraud, the State Supreme Court has reserved the decision of the Superior Court of Los Angeles County, which repaid to the Los Angeles Gas & Electric Company $11,278.12, State and county taxes paid under protest. The gas company had alleged that this sum represented the excess taxation upon its property demanded by the assessor, and that the assessor not only over-valued the property, but discriminated against the concern. The trial court found that there had been certain discrimination on the assessor's part. The gas company, however, had protested to the Board of Equalization, and the board had declined to reduce the amount. For this reason, rules the Supreme Court Justices, the company must pay the amount upheld by the board.

LOS ANGELES, CAL.—The Supervisors have decided to offer for sale the franchise authorizing three sixteen-inch pipe lines to convey natural gas from the Midway oil field to Los Angeles. The expected battle between the Midway Gas Company and the Los Angeles Gas & Electric Company with respect to the franchise did not materialize. The franchise provides that the successful bidder must put up a $25,000 bond and that the work must be finished in three years. The whole project will cost $1,500,000, of which $200,000 must be expended six months after the sale of the franchise. The time of duration of the franchise is 40 years. The pipe line is to follow the aqueduct as nearly as possible to San Fernando alredy arranged for the entire output of the gas wells and thence to the city limits. The Midway company has already arranged for the entire output of the Honolulu Consolidated Oil Company in the Buena Vista Hills district of the Midway oil field, and is understood to control considerable natural gas production nearer home.

TRANSMISSION.

SACRAMENTO, CAL.—Edward Whaley, secretary of the Northern California Power Company has confirmed the rumored purchase by his company of the Sacramento Valley Power Company, but reserved a statement as to the price and terms of purchase until certain legal steps, which are necessary to complete the deal, have been taken. The Sacramento Valley company was organized two years ago by Herbert and Mortimer Fleishhacker and their associates by the consolidation of several smaller companies and has proven an aggressive competitor for the light and power business of the northern counties. Talk of a merger by purchase has been current for some time, and officials of both companies have now confirmed the statement that the terms have been agreed upon and that only the legal transfer remains to be attended to.

BANDON, ORE.—The Bandon Water Company has taken over the holdings and franchises of the Bandon Light & Water Company and has elected the following officers: President, E. E. Johnson; vice-president, L. H. Hazard; secretary-treasurer and manager, Geo. Laird. The firm has outlined extensive improvements to be soon under construction, among which are new reservoirs, three dams and about 1300 lineal feet of flumes, with over 5000 cubic yards of excavation, the laying of several thousand feet of pipe, tile drain, etc. The plans include a clear-water reservoir of 3,000,000 gallons capacity and two settling reservoirs of 5,000,000 gallons capacity. The plans for this work were prepared by L. F. Blaz, civil engineer.

TRANSPORTATION.

PORTLAND, ORE.—Six suits are pending to condemn a right of way for the Albany-Eugene extension of the Oregon Electric.

PASADENA, CAL. The Pacific Electric Railway Company has been granted a franchise to construct and operate an electric railway upon Washington street.

BURLEY, IDAHO. Petitions are being circulated among settlers to request the County Commissioners that they grant to Albert Pleoger and associates a franchise for the purpose of building electric railroads.

LEAVENWORTH, WASH. Bonds to the amount of $1,000,000 for the purpose of constructing the electric line from Wenatchee to Leavenworth, have been sold, according to Mr. Folt of the Wenatchee Valley Railway & Power Company.

SACRAMENTO, CAL. Business on the line of the Central California Traction Company has increased 75 per cent during the last year, says Geo. W. Peltier, vice-president of the line. The first month of the line's second year has just been checked up and the discovery made that business has almost doubled.

SAN BERNARDINO, CAL. The Southern California Edison Power Company has awarded a contract to S. Starkweather for the construction of a power line. From a point near Colton it will pass south of Bloomington, through Chino Valley and tie in with the line near Los Angeles. The contract price given is $12,500.

ALBUQUERQUE, NEW MEXICO. Valley farmers have signed contracts for the building of a power line six or seven miles down the valley on the east side of the river, to carry electricity sufficient to irrigate land along the route. Work will be started at once and will be completed about March 15, if favorable action is taken at a meeting of the farmers this week.

OGDEN, UTAH. The Ogden Rapid Transit Company has applied for a franchise to build an electric car line on the county road in Ogden Canyon, over the territory occupied by the Oregon Canyon Resort Company. It is understood by the Commissioners that the Rapid Transit Company desires to extend its interurban line from the Hermitage in the canyon to Huntsville.

FRESNO, CAL. Construction work on the railroad to F. Creek from Gordon Switch, five miles from Clovis, has started with a big force of men and teams. The road is being built by the San Joaquin Light & Power Company to transport material to its big power plant, which is under construction. The line, which will pass the Fresno copper mine and connect the mountains with this city by rail, will cost about $75,000.

PORTLAND, ORE.—The Southern Pacific Company is endeavoring to have the council pass an ordinance allowing them to electrify and double track their line on Fourth street. If the ordinance passes the company will immediately electrify and double track both the Yamhill and the Fourth street lines between Portland, St. Joseph, and McMinnville, as well as a connection between the Jefferson street depot and the Fourth street line in Portland. About $1,600,000 has been set aside for this, and as soon as these improvements are completed the work will be extended to Corvallis, Eugene and finally to Salem.

TELEPHONE AND TELEGRAPH.

SANGER, CAL.—An application has been made to the Board of Trustees of the city of Sanger for the purpose of erecting a telephone line for a period of 25 years. The Board of Trustees will receive sealed bids for the sale of this franchise up to March 7th, 1912.

PORTLAND, ORE. The 16.47 per cent increase in the number of the Pacific Telephone and Telegraph Company phones in Portland, the last year, is the greatest percentage increase on the Coast. San Francisco is next with 11.27 per cent. The number of phones in Portland is now 33,933.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company shows a profit of $1,569 during the year. Its receipts were $1,239,112, including $30,638 for outside tolls. The expenditures were $1,237,816. The plant valuation is reported as $6,839,101, an increase of $793,811 during the year.

SAN FRANCISCO, CAL.—The Home Telephone Company submitted its report for the year 1911 to the Supervisors this week. It showed that the local plant had cost $6,248,705.92, of which $154,992.53 was for construction last year. The year's revenues from local business were $355,073.43, and $15,058.09 from outside switching, or a total of $370,131.52. The cost of maintenance and operation was $265,880.60.

LOS ANGELES, CAL. The Home Telephone Company's report again shows an inability to make receipts meet expenditures. The report shows receipts $1,195,179 and expenditures $1,260,128, showing a loss of $65,000 for the year. But the item of expenditure includes an obsolescence and depreciation charge of $537,835 on a plant valuation of $7,039,626. Long-distance receipts, included in the preceding totals, amount to only $23,636.

LOS ANGELES, CAL.—Thos. Foulkes, of the Board of Public Utilities, has reported to Mayor Alexander that an interchange of service between the Pacific Telephone & Telegraph Company and the Home Company is impracticable. The plan of the city having 25 inter-trunking lines would simply be a makeshift and not a cure. Ideal and economical service can be obtained only by the elimination of one or the other of the companies.

FRESNO, CAL.—Within a short time the telephone line now being built from Clovis to North Fork, Madera County, will be completed. This line is being constructed by H. E. Bigelow, proprietor of a stage line out of Friant to North Fork. As soon as this last piece is finished the line will be connected up and people in Fresno will be able to talk into the mountains. At North Fork and O'Neals the Bigelow line will connect with the forest service telephone lines which extend from Trimmer Springs on the south to El Portal on the north and will thus allow outside communication with the forest service. The government operates about 200 miles of telephone line in the Sierras between Trimmer Springs and El Portal. In the past it has been necessary in order to communicate with the outside, to use the telephone line of the San Joaquin Light & Power Company, but with the establishment of the new line, which connects with the Pacific Telephone & Telegraph Company lines, the power line will be used only by the power company.

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JOURNAL OF ELECTRICITY

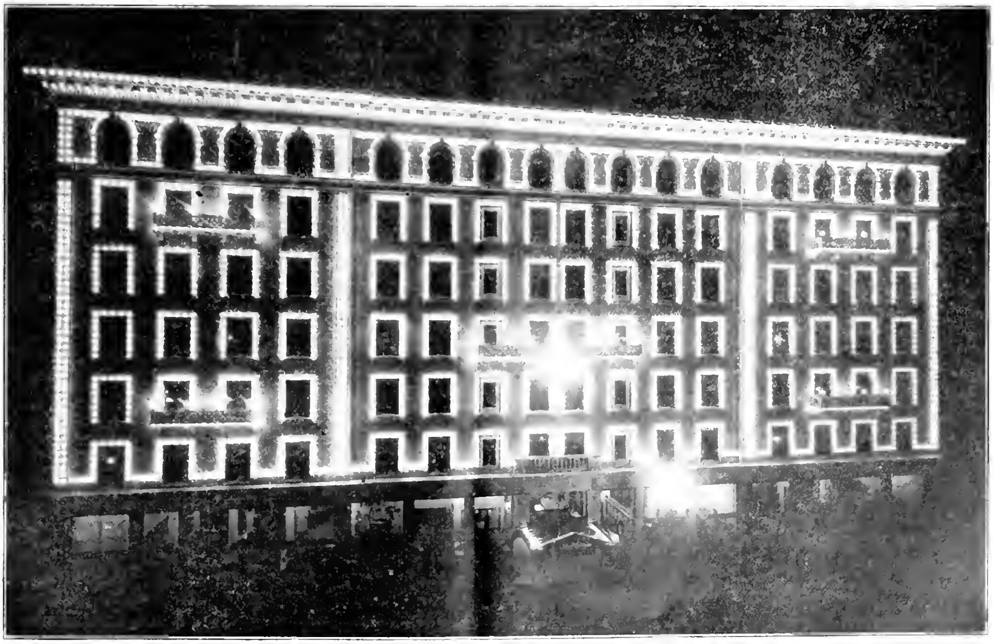
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII SAN FRANCISCO, FEBRUARY 17, 1912 NUMBER 7

DECORATIVE LIGHTING IN SAN FRANCISCO

At 7 p. m. Friday, February 9th, Miss Cora Otis closed the switch controlling the current to the decorative lighting on the front of the new Temporary City Hall, thereby inaugurating a new era for what is to be the civic center of San Francisco.



Decorative Lighting of the Temporary City Hall, San Francisco.

The Temporary City Hall is a seven-story, reinforced concrete building, erected by the Whitcomb Estate, James Otis, trustee, and leased to the City of San Francisco for a period of three years for use as a City Hall. It is located on the southerly side of Market street, west of Eighth street, and has a frontage of 200 feet, extending back to Stevenson street, a distance of 165 feet. In it are to be housed the Mayor, Supervisors, Tax Collector, Assessor, County Clerk and the various municipal departments.

The decorative lighting system is the most complete and extensive on the Pacific Coast and was designed as an integral part of the facade, all the outlets being set in the forms before the concrete was poured.

In all 2540 five-watt, 12-volt tungsten lamps were used, outlining all the windows, balconies, pilasters and the cornice. The balcony posts and corners of the marquise are topped with 12-in., rough inside, spherical globes, each fitted with a 40-watt, 110-volt

tungsten lamp. The five-watt lamps are divided into seven sections, each section having its own transformer, located in the center of distribution, and housed in a cabinet, recessed into the front and behind the balcony, with the exception of the top, front section, the transformer for which is located on the roof.

Incorporated in the transformer housings are the secondary distribution panels, arranged as three-wire circuits, each carrying approximately 8½ amperes. Transformer primaries are fed from the 220-volt bus bars on the main switchboard, each with an independent circuit. Each balcony has, also, a separate 110-volt circuit fed from the main switchboard, permitting of any desired combination of front illumination.

Transformer secondaries are wound for 12-24 volts with an output of two kilowatts. Each secondary, three-wire circuit feeds the center of a group of thirty-five lamps.

Both primary and secondary leads are proportioned to give a practically uniform voltage to each lamp and as an economical system of decorative lighting it might be stated that the cost of operation will not exceed 45 cents per hour for the entire system.

The architects, Wright, Rushforth & Cahill, have designed a building which will greatly enhance the appearance of that section of the city and form a fitting headquarters for the progressive city officials who are to do so much for San Francisco in the next four years. Much credit is due to the Central Electric, Plumbing and Heating Company for the excellent manner in which the installation was carried out.

COPPER STATISTICS.

The United States Geological Survey have collected statistics from producers of blister copper and from Lake mines for the first eleven months of 1911. Taking these figures, and estimating the December output and incomplete returns for November, the Geological Survey report a United States production of copper for last year amounting to 1,091,554,000 pounds, against 1,080,159,509 pounds in 1910 and 1,092,951,624 pounds in 1909. Imports of copper in 1911, (Dec. estimated) were 340,480,000 pounds, and these to the above figures we have a total United States supply in 1911 of 1,432,034,000 pounds. These returns compare with the Copper Producers' report of the production of $1,431,938,338 pounds of marketable refined copper in 1911. The closeness of these two sets of statistics compiled by different authorities is remarkable.

Copper statistics for United States per returns by Producers' Association, in pounds:

	December.	November.	Increase.	Decrease.
United States production	122,896,697	111,876,601	11,020,096	
Domestic Deliveries and Exports	115,227,190	135,089,055	10,138,135	
Stock end of month	89,451,695	111,785,188		22,330,493

Total production, 1911.....1,431,938,338 lbs.
Total deliveries, 1911.....1,461,513,838 lbs.
Decrease in stocks, 1911 .. 32,575,300 lbs.

GRAPHICAL ANALYSIS OF ALTERNATING CURRENT PHENOMENA.

BY A. L. MENZIN.[1]

In the Transactions of the American Institute of Electrical Engineers for June, 1911, there appeared a discussion on the relative advantages and disadvantages of the two graphical methods of representing alternating current phenomena in common use—the so-called crank diagram, favored by some, and the polar diagram advocated by others.

Judging from this discussion, it seems to be held that although the polar diagram is more logical and broader in its scope, yet it does not serve to give as clear ideas of instantaneous relationships as well as the crank diagram.

Some time ago the writer was working on an experimental electric generator and found it necessary to work out the time-magnitude relation of induced e.m.f's. in order to predict what would happen if certain windings were modified. He found the polar diagram as commonly used unsatisfactory; and, after searching for a more suitable method, discovered that if the polar diagram—a diagram based on polar co-ordinates—is used in the restricted sense in which it is set forth in text books on analytical geometry, that is purely as a graphical method of representing values, without any reference whatever to the conventions of harmonic motion, the difficulties vanished.

It is questionable if the common use of effective values, even as a short cut to quantitative solutions, is not a serious obstacle to a clear comprehension of instantaneous relationships. Effective values, being mere averages indicated by instruments actuated on the dynamometer principle, are therefore not actually referable with respect to time. To give them a false time relationship is to give them a significance which obscures their real meaning.

Another difficulty is the association of the term rotation in connection with polar diagrams. Rotation is no more inherent in the polar co-ordinate system than is the notion of translation in the rectangular system. In a very special case, that of the bi-polar machine, the period becomes co-incident with one revolution of the armature and, in this case, one may consider the rotating vector as representative of a rotating armature conductor. But when this notion is extended to multipolar machines, confusion begins.

To use the polar diagram in its mathematical sense, it is necessary to go back to first principles. The key to any system of plane co-ordinates is that a simple graphical mark represents two separate and distinct magnitudes. Thus, in a diagram based on rectangular co-ordinates, a point represents two magnitudes by its distances from two fixed lines at right angles; in a polar diagram, a vector represents two magnitudes by its length and by its angular displacement with respect to a fixed line. If there is some continuous relationship between the magnitudes, the points in the first mentioned diagram, and the vectors in the other, become adjacent and the result is a line, or curve, which is called the "graph" of the phenomenon represented, or the "locus" of the equation which expresses the relationship.

[1]Mechanical Engineer, San Francisco.

Thus in Fig. 1, O is a fixed point called the "origin" from which all vectors begin. O A is a fixed line called the "initial line from which angular distance is measured, and M N is the graph showing the relations between the magnitude plotted in lengths

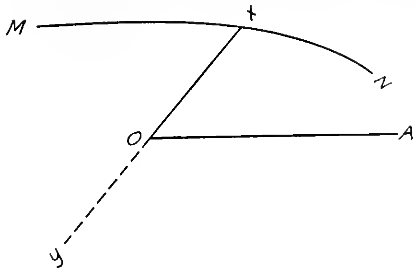


Fig. 1 A Polar Graph.

of vectors and the magnitude plotted in angular displacement of those vectors. Any vector as O X represents one magnitude by the length O X, and the corresponding magnitude by the angle A O X. The length of the vector is positive when measured along the closing side of the angle considered, and negative when measured in an opposite direction. The angle is positive when measured in a counter-clockwise direction and negative when in a reverse direction. Thus in Fig. 1, the length of the vector corresponding to the angle A O X is O X and is positive; the length of the vector corresponding to the angle A O Y is also O X but is negative.

Due to the usual mechanical construction of electrical machines and to the laws governing magnetic induction, the instantaneous relationship between time and e.m.f., current, flux, etc., is expressed approximately by an equation of the form $i = I \sin \frac{2\pi}{T} t$ where i is the instantaneous value of the oscillatory quantity, I the maximum value, T the period of the oscillation, and t the time corresponding to the value i measured from the beginning of the oscillation.

If, in a polar diagram, time is plotted as angular displacement to the scale of one degree or 1/360th of the period, then the period is $T = 360°$, or 2π, and, by substitution, the above equation becomes $i = I \sin t$, where t is now expressed in degrees. By referring to text books on analytical geometry it will be found that the polar locus of an equation similar to the above is a circle passing through the origin whose center lies on a line 90° distant from the initial line. It is evident that the angular position of the initial line will not affect the shape of the curve, the only effect of placing the initial line elsewhere than at 90° to the diameter is to change the arbitrary zero of time. It is also evident that the maximum vector which can be drawn from the origin, which must always be on the circle, is the diameter. From the above follows the fundamental fact that the polar graph of every oscillatory magnitude expressed by an equation of the form $i = I \sin \frac{2\pi}{T} t$ is a circle passing through the origin when time is plotted to the scale of $360° = T$. The diameter of this circle is equal to the maximum value of i.

One reason for the adoption of the polar diagram in representing alternating current phenomena is now seen; for, next to the straight line, the circle is the simplest curve to draw. But there are other reasons.

The superimposed or additive effect of two or more oscillatory magnitudes whose graphs are circles through the origin is also represented by an equation of the form $i = I \sin \frac{2\pi}{T} t$, and the graph of this effect is also a circle whose vectorial diameter—the diameter which originates at the origin—is determined in length and position by taking the vector sum of the vectorial diameters of the component circles, which may be done by the parallelogram method.

Before considering a problem involving the above it is necessary to define a few terms in common use. The term "phase," like many other words, has various meanings but its significance in this discussion is taken to be the time corresponding to a given instantaneous value. Thus the phase of the maximum value of a current is the time when that current is existent. From this it is evident that such expressions as "phase of a current" is indefinite unless some particular value of the current is specified or understood. Since every vector represents a length and an angle, it is proper, when the angle represents time, to speak of the phase of a vector, meaning the time corresponding to the magnitude which the length represents. Phase difference means difference in time between two instantaneous values. Thus the phase difference between the zero and maximum values of an alternating current is one-quarter of a period, and the phase difference between the maximum values of two currents of a three-phase system is one-third of a period.

One instantaneous value "lags" behind another when it becomes existent at a later time, and "leads" another when it becomes existent at an earlier time. Thus, the maximum value of the current from an induction motor lags behind the maximum value of the impressed e.m.f. because the current reaches this value later and vice versa, the maximum value of the e.m.f. leads the maximum value of the current because the e.m.f. reaches this value earlier.

To be consistent with the above expressions such as "the current lags 15 degrees behind the e.m.f." must be stated differently. The terms lead and lag, as defined above, have to do with time, and therefore have no inherent relation to angular measure. From this point of view it is no more consistent to say that "a current lags 15 degrees," because time is represented in angular measure on a diagram than it is to say "the temperature rise is 15 inches," because temperature happens to be represented on a diagram in linear distance. A correct way of stating the above is to say that the current (meaning the maximum value) lags 15/360ths of a period behind the e.m.f. This is true no matter what system of co-ordinates is employed and has the very great advantage of keeping in mind the real significance of the terms phase,

phase-difference, lead and lag, without detracting in any way from the readiness with which these may be represented in polar or rectangular co-ordinates.

To show clearly the application of the principles stated above, a simple alternating current circuit will be considered. Fig. 2 shows this circuit diagrammatically and the graphical representation of the electromotive forces involved. This latter is brought about as follows: Draw the vector O — I to represent the phase of the maximum value of the current. Then the maximum counter e.m.f. of resistance will lie along the vector O — I R, displaced by a half-period since the e.m.f. of the resistance always opposes the current and is proportional to it. Let O — I R equal the maximum value of this e.m.f. to some convenient scale, and circumscribe the circle about this vector as a diameter. This circle is the graph which shows the value of the counter e.m.f. of resistance at every instant. The maximum value of the e.m.f. produced by self induction lags one-quarter of a period behind the maximum value of the current. Its phase is therefore represented by the vector O — I X. Let the

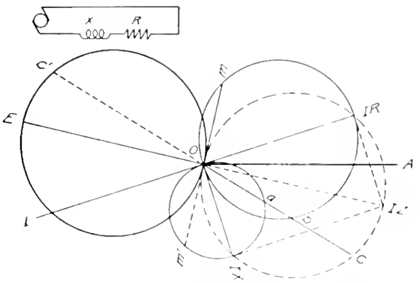


Fig. 2. Graphs of Electro-motive Forces in a Single Phase Circuit.

length O — I X equal the maximum value of this e.m.f. and circumscribe the corresponding circle. This latter represents all instantaneous values of the e.m.f. of self induction in phase and magnitude. To find the maximum value of an e.m.f. which represents the sum of the e.m.f's. of resistance and induction draw the parallelogram with sides O — I R and O — I X. The diagonal O — I Z is this maximum value and the circle circumscribed about O — I Z is the graph of the equivalent e.m.f. Since, by Kerchoff's law, the impressed e.m.f. must be equal and opposed to the resultant of all other e.m.f's. at every instant, the phase of the maximum value of the impressed e.m.f. is represented by the vector O — E displaced one-half a period from the resultant maximum e.m.f. O — I Z. Also the length O — E must equal O — I Z. The circle circumscribed about O — E is the graph of the impressed e.m.f. at every instant.

From the circles O E, O I R and O I X, the corresponding values of all e.m.f's. at any instant may be determined by measuring the intercepts on a vector corresponding to the instant in mind. Thus, at the time corresponding to the vector O — c the counter e.m.f. of resistance is represented by the length O — b, the e.m.f. of self induction by the length O — a, the resultant counter e.m.f. by the length O — c, and the impressed e.m.f. by the length O — c'. By Kerchoff's law, O — c' must equal (O — a) + (O — b).

At the time corresponding to the vector O — c, the e.m.f. of both resistance and induction are opposed to the impressed e.m.f. At the time corresponding to the vector O — I R the e.m.f. of self induction is zero and the e.m.f. of resistance alone opposes the impressed e.m.f. At the time corresponding to the vector O M the impressed e.m.f. is zero but the e.m.f. of self induction is of opposite sign to the e.m.f. of resistance, and therefore acts like an impressed e.m.f. in maintaining the current against the resistance R. And so on.

It is thus seen that the polar diagram as here used offers an exceedingly simple means of representing the characteristics and instantaneous values of the oscillatory quantities met with in electrical theory. For the purpose of determining instantaneous values the polar diagram is much simpler than the crank diagram; for, in the polar diagram it is only necessary to draw a line, while in the crank diagram it is necessary to draw a line and project the vectors upon it.

To use the polar diagram as above it is necessary that maximum values be known. These are not directly obtainable since instruments indicate "effective" values—the square root of the mean square of the instantaneous values. Fortunately, when the instantaneous value varies according to the sine law, the maximum value is equal to the effective value $\times \sqrt{2}$. Hence the one may be computed from the other arithmetically or may be scaled direct from the diagram by changing the scale factor. The maximum values may therefore be used at all times in graphical analysis without disadvantage.

It is seen from the problem considered above that the circle plays no part in the quantitative determination of the resultant maximum value of two or more component values. Only the vectorial diameters are used. Since one circle and only one can be circumscribed about a given diameter, the circles need not be drawn unless it is desired to analyze the problem qualitatively as well as quantitatively.

The polar co-ordinate system as here used differs from the method commonly taught in that all reference to the theory of harmonic motion has been avoided. One could be totally ignorant of the meaning of such words as wave, amplitude, projection, etc., and yet be able to use the polar diagram understandingly. As an instance, one may cite the readiness with which power plant operators learn to read the circular records made by the clock-driven recording instruments. These records are polar diagrams in the same sense as those used in this article and, although the ruling is sometimes modified on account of the mechanism which operates the pen, the theory is the same. An instrument might be devised which would draw the polar graph of a current as a parallel to the graph in rectangular co-ordinates drawn by the instrument known as the oscillograph.

POLARITY IN POLYPHASE CURRENT CIRCUITS.[1]

BY PROF. R. W. SORENSON.

The subject, which soon must be considered more generally and standardized, is the one of d.c. polarity, and by presenting a few practical problems we can see the value of its application.

Prof. Ryan has called our attention early in his paper to the well known and hence so often forgotten fact that it is the external angle between vector circuits, representing polyphase currents or electromotive forces, that measures their difference in phase, thus permitting the addition of these quantities without the use of an extra negative sign as is so often the practice.

Before taking up the specific problems which I wish to use to illustrate the value of a careful analysis of polyphase polarity, let us get before us the relation of electric quantities in picture and in vector diagram, and also a general idea of what polarity is in any alternating current circuit.

In Figs "1a" and "1b" there is represented by vectors and by rectangular co-ordinates, a balanced three-phase system of currents in Y connected circuits. Now let the maximum value of these currents be 1.0, then at the instant when the current in phase A has reached this value or what may be called the positive side of the base line, that is, has a value of + 1.0, it will be seen from the figure that phases

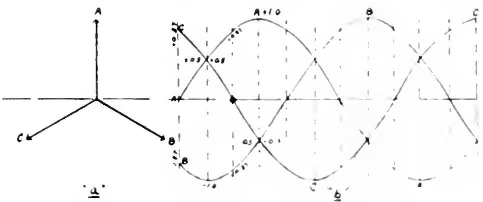


Fig. 1. A Balanced Three-Phase System

B and C are each equal to —0.5. If, in addition to this system of designating these quantities, we assign to a rising current a + sign to show its direction or instead of using this sign a "O" is used at the instant chosen (when phase A is at maximum value) in order to avoid confusion, phase A can be designated by the double sign "+O", phase B by "— O" and phase C simply by the sign "—". Here no direction sign is used in showing the negative action of the circuit, the sign as shown for C really stands for a double negative. That is, it is very evident that to be completely represented as to direction and also with relation to its circuit, each phase must carry with it a double sign, one to represent the position of the circuit and one to represent the direction of the current of electromotive force at any instant. Also it is evident that there is a constant relation between the currents in the different phases and that any equation which may express the value of the current in one phase will serve to express the value of the current in either of the other phases by the simple addition of a constant which expresses the phase relation between the quantities represented.

Since the condition here outlined is that which may occur at any instant, we may conclude that it represents every instant, and thereby gives us a most definite basis for the establishment of such a thing as polyphase polarity.

In considering polarity in any a.c. system, whether single phase or polyphase, as compared to polarity in a d.c. circuit, there are these differences: the relation between current flow and the circuit in a d.c. system is constant, whereas in an a.c. system the current or electromotive forces are continually changing and repeating every cycle; and there can be no difference of phase between d.c. currents in circuits which are joined together, and moreover there can be a difference in phase between currents or voltages in a.c. circuits that are joined together.

As to a.c. polarity in general, let us consider for a few moments the single phase transformer. All of us know that when we wish to multiple two or more of these, we must first determine the polarity and connect together leads which have like signs, in accordance with the method used to designate leads which go together and thence to the lines. This can of course be most conveniently done by marking one primary lead of each transformer "+" and the other "—" after which the same thing is done in regard to the secondary leads as in Fig. 2, due consideration being given to the relation between the P winding and the S winding in each case. With only the single phase relations to consider, this is of course, perfectly proper, and is fully warranted by the simplicity of such a designation, but when these same single phase transformers are to make up a part of some polyphase set there must also be added the other sign, for reasons which will be developed later, and hence in order to lead up to this, I will show the vector circuits for two open core single phase transformers as illustrated in Fig. 3. To do this we must first establish a standard, which can be done in one of two ways. The transformer can be considered as a motor generator set, with the primary as the motor and the secondary as the generator, in which case to be analogous with the system used in direct currents an instant would be selected when the current was going into a particular lead of the primary winding and the direction the current then had in this lead called "+", at this same instant the lead on the secondary side in which the current is flowing out as in a generator would be given the sign "+", which lead this would be, being determined by the direction in which the secondary is wound as compared to direction of winding of the primary. Or another plan may be adopted in which both primary or secondary leads carrying current into the transformer at some particular instant are designated as the positive leads.

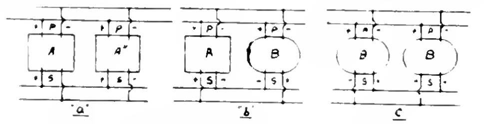


Fig. 2. Single Phase Transformers in Multiple.

This latter method is I believe the one most generally used because of the fact that it so readily lends itself to the determination of transformer polarity by the direct current method, although personally I am in favor of the first scheme suggested, viz: that of calling the secondary winding a generator and the primary winding a motor. But for the present we will adhere to the other standard and determine our polarity by the direct current which is as follows:

Fig. 3. Vector Circuits for Two Open-Core Single Phase Transformers.

Given a transformer as in Fig. 4, to determine its polarity.

Connect to the primary coil leads A and B a direct current supply of low voltage so that only a small current will flow. If lead A is connected to the positive side of the d.c. supply and B to the negative, place a d.c. voltmeter on the leads C and D with the positive terminal connected to C and the negative terminal connected to D. Now suddenly break the circuit connected to C-D by opening switch S quickly and the voltmeter V will show a deflection or "Kick." If this kick is

[1]This paper is a discussion of Professor Ryan's paper on Polarity in Polyphase Circuits which was presented at a meeting of the Los Angeles Section of the A. I. E. E., Nov. 21, 1911, and appeared in the columns of the Journal on Nov. 11, 1911.

[illegible]

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In the ... [illegible]

For ... [illegible]

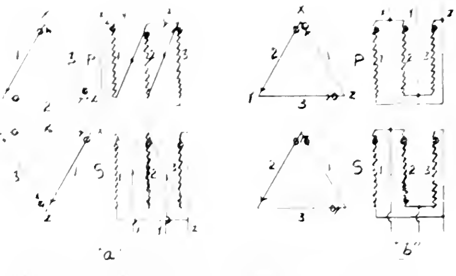


Fig. 6. [illegible] Connection of [illegible] Transformers.

[illegible] ...tained a three-phase standard to be used for checking [illegible] of three-phase machines that are built in the shop [illegible] execution of this test on an efficient basis as well [illegible] proper design of polyphase apparatus of this kind [illegible] method for checking the rotation between the [illegible] graphically or by means of vectors, be devised.

[illegible] Fig. 6, which shows diagrammatically [illegible] delta-delta [illegible] any scheme [illegible] multiple operation [illegible] Fig. 6a represents [illegible] in a case

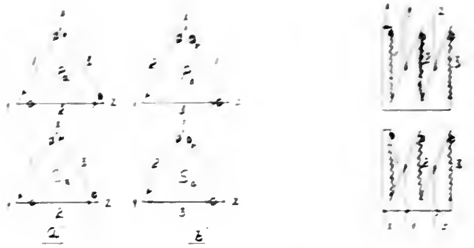


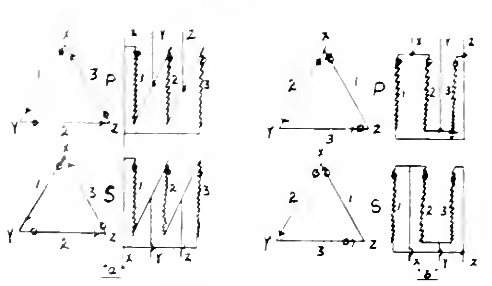
Fig. [illegible]

[illegible] shows the same thing for a [illegible] connected in the same [illegible] YB and ZA to ZB. These [illegible] clearly that the second- [illegible] as has been already stated. [illegible] a vector diagram solution [illegible] multiple operation, con- [illegible] standard and proceed to [illegible] To be connected together [illegible] a and [illegible] must be parallel [illegible] Fig. [illegible]

[illegible] thus obtained it is evident [illegible] S—1 should be connected to [illegible] the negative end of [illegible] end of S [illegible] and so on. As in [illegible] the transformers if of proper [illegible] with the P leads and [illegible] ZA to ZB as in Fig. 9.

[illegible] secondary coils of these transformers [illegible] as in Fig. [illegible] a.

[illegible] from one voltage to another by [illegible] compensators offers another [illegible] circuits, especially in the [illegible]. For example let us as- [illegible] most economical way of chang- [illegible] volts, two-phase to three- [illegible] phase at the same voltage.



[illegible] Connections to be Made.

This change can of course be made by means of two transformers each having a capacity of 50 k.v.a. which are properly wound for three phase two-phase transformation of power when "Scott" connected, but there is a cheaper way than this both in point of first cost and in economy of operation and that is by the use of a "T" or "Scott" connected auto-trans-

former, or compensator as illustrated in Fig. 10a. The vector current diagram is shown in Fig. 10b.

Conditions of operation:

Two-phase.		Three-phase.
1000	volts	1000
100	K.V.A.	100
50	amperes per line	57.7

Inasmuch as the change of voltage is made by transformer action we can say in general that the three-phase voltages and currents will be in opposition to those of the two-phase circuits. In the winding ABCM the following conditions will exist. Current in AB, 50 amperes; current in BM, (50-57.7) amperes equals —7.7 amperes.

In circuit DM there flows a three-phase current in the direction indicated by vector circuit DC, and a two-phase current shown by vector DM, while in circuit ME there exists a similar condition as shown by vector circuits CE and ME.

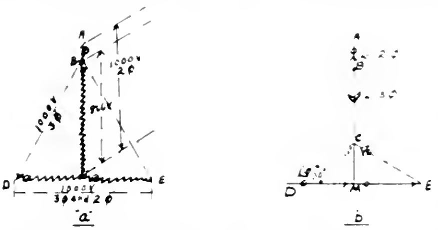


Fig. 10. Scott Connection of Transformers.

Now from the figure 10b, it is evident that a part of the current CD is in phase opposition to current DM and also since there is no current directly in phase with the vector CD the current CM must be carried by the circuit DM figure 10a. Or for this special case there will flow in circuit DM the current represented by vector CM, which is one-half current CD, as will be seen by an inspection of the right triangle CDM. For the general case in which the three-phase and two-phase voltages are not equal, the current in each half of the winding of the main transformer will be found by the equation

$$I = \sqrt{(I_2 - .866\,I)^2 + \left(\frac{I}{2}\right)^2}$$

When I is the current flowing in the main transformer,

I_2 is the two-phase line current

I is the three-phase current.

For the problem which we are working we have

$$I = \sqrt{(50 - .866 \times 57.7)^2 + \left(\frac{58}{2}\right)^2} = 29 \text{ amperes}$$

Summing up and tabulating we have:

Circuit.	Current.	Volts	K.V.A.
AB	50 amps.	134	6.7
BM	7.7 "	866	6.7
DM	29 "	500	14.5
	29 "	500	14.5
Total			44.4

A transformer has, however, two windings, each of which will carry the k.v.a. rating while the auto-transformer or compensator has but one winding in which there is 44.4 k.v.a. This rated on a transformer basis would be $\frac{44.4}{2}$, or 22 k.v.a. auto-transformer. That is for this particular case the 100 k.v.a. can be changed from 100 volts, three-phase by the purchase of a 22 k.v.a. auto-transformer rather than with two 50 k.v.a. transformers which must have in the three-phase winding 15 per cent excess of copper over that of standard transformer and in operation this transformation will be accomplished with only such loss as will occur in a transformer of 22 k.v.a. capacity instead of with the loss due to the placing of two 50 k.v.a. transformers in the system.

THE FIRST PRINCIPLES OF THE STEAM TURBINE.

BY ROBERT SIBLEY

Historically the steam turbine is not a new idea. Hero, years before the dawn of the Christian era, invented as a play-thing, the steam turbine. Steam emerging from bent tubes caused this invention of Hero's to revolve. It was not until very recent times, however, that the turbine has assumed practical importance. De Laval was the first to make the turbine of practical value in order to utilize the energy inherent in steam to its fullest extent.

We have seen previously that enormous ranges of expansion of the steam are necessary in order to operate at maximum efficiency. Velocities almost beyond human conception are produced by allowing steam to expand adiabatically from high pressures and temperatures to extremely low pressures and temperatures. We shall soon see that in order to transform all of this energy of velocity by means of rotating buckets, the buckets themselves should move with a velocity equal, theoretically at least, to one-half the velocity of this issuing steam. The utilization of such enormous velocities early met with unsurmountable mechanical difficulties.

The first application of the steam turbine was in the separating of cream on the farm. The enormous velocities produced easily caused the cream to separate by means of centrifugal force. De Laval, however, found it necessary to make a movable shaft support for his rotating parts due to the great velocities experienced and the uneven forces encountered. This was done in order to allow the pivot of rotation to at all times coincide with the center of gravity of the rotating parts.

The immense practical application of the steam turbine so far as power development is concerned is in a great measure due to the inventions of Parsons and Curtis whereby the steam is utilized through several stages of expansion. We shall soon see that the velocity produced bears a direct relation to the amount of heat transferred from latent energy of heat in the steam to kinetic energy of motion. Consequently, if in expanding steam we allow it to take several separate stages in its expansion corresponding lower velocities become most efficient. Thus in the 12,000 kilowatt turbines which seem to have become so popular on the Coast of late, as a rule five stages of expansion are utilized, thereby making it possible to have speeds of only 720 revolutions a minute.

Let us for a moment trace the course of the water entering the boilers until it again comes back to the boiler after being returned as water from the condenser of the turbine.

The water is first passed through a feed-water heater which as a rule is heated by means of the exhaust from the non-condensing auxiliary apparatus of the power station. It is next forced into the boiler or at times through an economizer. This economizer may in chance be located in the flue of the escaping gases, or as in the case of the Parker boiler, it may be directly located in the boiler itself. The water heated,

[illegible] the Twentieth Lecture of a series appearing [illegible] entitled "Primer of Applied Thermodynamics."

now to a temperature almost that of the saturated steam, enters the water drum of the boiler. From there it is fed through tubes which are exposed to the highest temperature of the furnace, returning to the steam drum as saturated steam or as water on the point of evaporation.

The saturated steam formed in the steam drum is next conducted through a superheater, which as a rule is in the form of tubes of small diameter located in the furnace proper although not exposed to the highest temperatures. The saturated steam passing through these pipes heated to a high temerature now becomes superheated and in the use of the turbine installation above referred to, it is usually taken to the turbine at a temperature of about 100 degrees above that of the temperature of the saturated steam for the pressure at which the turbine is designed to operate.

By means of properly designed asbestos lined steam pipes this superheated steam is taken directly to the steam turbine where it passes through nozzles, if the turbine be of the so-called impulse design, or through guides if it be of the so-called pressure design. The steam then at once emerges upon rotating blades or buckets, forcing these buckets to maintain a constant uniform rotation. Through all of this process the steam is expanding and as no heat is given out or transferred to the steam, the expansion is almost ideally adiabatic. In the case of the impulse type of turbine, the steam, by means of the nozzles through which it passes, is so expanded that it possesses an enormous kinetic energy.

The small particles of steam beating against the buckets of the turbine transform the major portion of their kinetic energy of motion to the rotating parts of the turbine which in turn generate electric energy. In the case of the pressure type however, the steam is not expanded in the stationary entering device but expands directly in the rotating buckets themselves, thereby causing rotation by pressure of the expanding steam.

When the steam has passed through a series of fixed nozzles or guides and then again through rotating guides or buckets it finally emerges into the condenser with all of its energy of motion almost completely absorbed. At this point, cool water circulates through a mesh-work of steam pipes measuring literally miles in length. The steam now coming in contact with this constantly maintained cooling surface, condenses into water. A vacuum is thereby maintained which is still further perfected by means of a dry vacuum pump which exhausts from the condenser any remaining air or steam. By means of the wet vacuum pump, the water of condensation is now lifted out of the condenser into the so-called "hot well," where new water is being added from without in sufficient quantity to again supply the boiler in this continuous cycle of operations.

Let us analyze the construction of a typical modern turbine. The rotor consists principally of three drums (R), Fig. 1, of varying diameter, consisting of high, intermediate and low pressure stages which have all end thrust neutralized by counter-balancing pistons (P). Pressures at various stages are connected to the balancing pistons through equalizer passages (E). In general, this section represents the usual construction of all Parsons turbines. There is, of course, some departure made in different builds, chiefly in the arrangement of balancing pistons. This, however, is of no importance in the sizes in which the construction here illustrated is mainly used. Two self-aligning high-speed bearings (B) are used. Steam is introduced at (S) and controlled by the main admission valve (V) (to the right) admitting to the annulus (A). To provide for heavy overloads, steam under full pressure is supplied to the secondary valve (V) (to the left). A valuable provision is made to keep the governor valves in a constant vibrating motion, and in this way no friction of rest or sticking of the valves is to be overcome for any change in governor position. Thus the regulation of this turbine has always been above criticism. The exhaust passage is shown at (D). Water sealing glands at (W) positively prevent any inflow of air to the turbine, which would obviously impair the vacuum. New blading

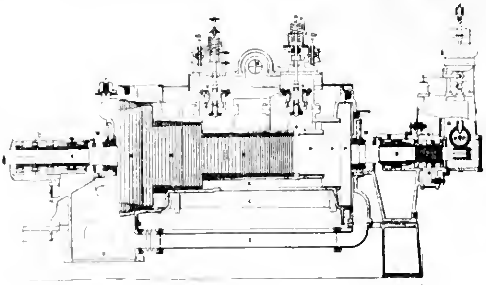


Fig. 1. Section Through a Typical Single-Flow Turbine.

formation and construction is plainly an important feature of tht turbine. Probably no other detail of the design has been the subject of such extensive experimentation as has been accorded the blading itself. Various blade shapes and methods of securing them to the rotor and cylinder have been exploited since the early turbines were built. Blading sections and lengths are now made so as to effect an almost ideal expansion of the steam passing through the turbine. In attaching the root of the blade, the problem is remarkably simple, the blade being provided with a small neck at the root and held by the compression forces of the caulked soft steel packing pieces. Under tension test, the blades will fail at some intermediate section before detaching at the root, due to the firm grasp of the packing pieces. Fastening of the blade tips has undoubtedly attracted the greater attention. Where there is a drop of pressure across each row of blades, it is preferable to maintain minimum clearances to reduce steam leakage. Some clearances may be actually beneficial to the economy of the turbine as it provides a passage for the water in the steam, permitting it to flow through without causing hydraulic friction on the tips of the moving blades, a theory advanced by experienced operators of steam turbines. A reinforcement of the outer ends is only necessary for long blades in order to avoid nodal vibration which might be set up in the steam currents, ultimately causing crystalization and failure of the blades. In the turbine shown, this is accomplished by a comma wire lashing which, on being clinched, establishes a stout abuttment between consecutive blades. Since the turbine cylinder has been made so symmetrical in design, distortion troubles have been removed.

The losses encountered in the operation of the turbine are four in number. In the first place, steam passing through the nozzles or guide vanes meets with a certain amount of friction in passing over the guiding surface. This friction reduces the amount of energy available for transference into kinetic energy. Secondly, we shall find that the actual angle at which the steam is allowed to enter the moving vanes and to depart from them is a most decided factor in the energy transferred to the rotating parts. After entering upon the moving vanes the steam meets again with friction in passing through them which is a loss that constitutes the third consideration and finally there are in the turbine the same losses due to friction which are experienced in any mechanical mechanism such as friction of bearings and journals, windage of rotation and the like.

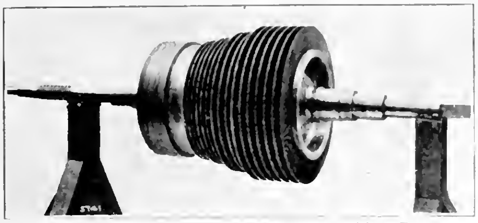


Fig. 2. Single-flow Low Pressure Turbine Rotor, 300 kw.

We learn from the theory of conservation of energy that, though energy may disappear in one form, it nevertheless is not destroyed, consequently if we sum up the different forms of energy in moving steam at one point in its movement and compare it to the energy at some other point, the energy summation in each case should be the same.

In Fig. 3, let p_1, v_1, T_1, E_1, K_1, H_1 be respectively the pressure, specific volume, absolute temperature, internal energy, kinetic energy and total heat per pound of steam as it crosses the entrance section of the nozzle in the steam turbine at A and let p_2, v_2, T_2, E_2, K_2, H_2 be the corresponding quantities at the exit section of the nozzle at E. We have previously learned that in addition to the internal energy of steam there is a certain amount of energy represented in external work which has been performed in the passing of the water into saturated steam. This amount of external work is found by multiplying the pressure times the specific volume. Hence the total amount of energy in the steam as it enters the nozzle at A is equal to $(E_1 + p_1 v_1 + K_1)$, in which we make a slight assumption by using v_1 instead of u in which u is the difference in volume between one pound of saturated steam and one pound of water. The difference between u and v_1 is however negligible for engineering computation. The energy at the emerging point of the steam at E is likewise $(E_2 + p_2 v_2 + K_2 + Q)$ in which Q is the amount of heat which has disappeared from the moving steam in the form of friction since the steam entered the nozzle in going from A to E.

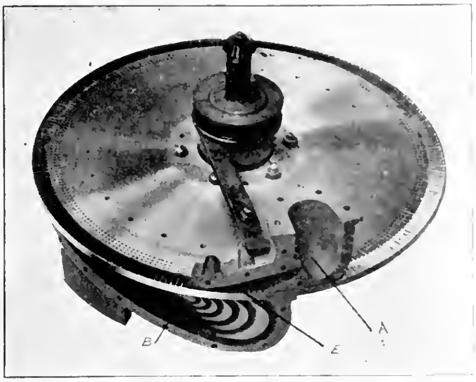


Fig. 3. Assembled Nozzle, Wheel and Reversing Passage.

Since unit kinetic energy is equal numerically to the square of the velocity divided by 2g and since the two energy summations above are equal one to the other we now write the following equation:

$$E_1 + p_1 v_1 + K_1 = E_2 + p_2 v_2 + K_2 + Q; \text{ or}$$

$$H_1 + \frac{v_1^2}{2g} = H_2 + \frac{v_2^2}{2g} + Q$$

$$\frac{v_2^2}{2g} - \frac{v_1^2}{2g} = H_1 - H_2 - Q \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

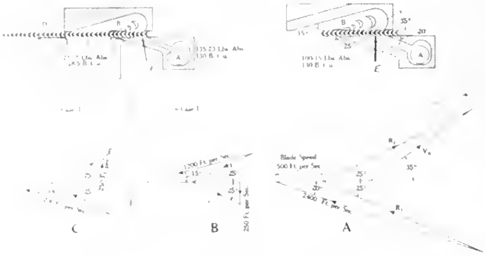


Fig. 4. Steam Velocity Diagram.

In the considerations of the turbine nozzle computation we may neglect certain quantities involved in this equation for the time being. Let us neglect $\frac{v_1^2}{2g}$, and Q. Hence we have $\frac{v_1^2}{2g} = H_1 - H_2$. Converting the right hand side of this equation into foot pounds in order to have our velocity in feet per second, we now have

$$\frac{v_1^2}{2g} = 778 (H_1 - H_2) \text{ or } v_1^2 = 2 \times 32.2 \times 778 (H_1 - H_2)$$

$$v_1 = 223.84 \sqrt{H_1 - H_2}$$

We are now able to compute the theoretic velocity of the steam emerging from the turbine nozzle and we shall find in the next lecture a correction to make to this theoretic velocity thereby taking account of the friction Q in order to arrive at the exact velocity. It is interesting to see the enormous velocities that the steam has in emerging from a turbine nozzle under ordinary temperature and pressure when but one stage of expansion is used in the steam turbine.

Before proceeding however to this computation it is necessary to review some of our principles of entropy in order to arrive at the proper value of H_2. This can be best brought out by illustration. Let us assume that we have a single stage turbine receiving steam at

150 pounds absolute and 600 degrees F. in temperature, which discharges the same into the condenser maintaining 2.0 lb., absolute pressure. In order to compute the value of H_2 it is necessary to know the quality of the steam as it enters the condenser. This we can only arrive at by taking into account our entropy equations.

By referring to Steam and Entropy Tables of Marks and Davis, we find that the total heat of steam under a pressure of 150 lb. absolute and 600 degrees F. temperature is 1316.6 B.t.u. Similarly by observing equal entropy relations we find that the total heat of the wet steam at 2 lb. absolute is 987.5 B.t.u. Hence the velocity of the steam issuing from the nozzle is

$$v = 223.84 \sqrt{H_1 - H_2}$$

$$= 223.84 \sqrt{H_1 - H_2} = 223.84 \sqrt{H_1 - H_2} = 4060 \text{ ft. per sec.}$$

In the next lecture we shall look more carefully into this velocity relation and also into methods involving the computation of the quality or wetness of the exhaust steam.

Solution of Thermotwisters—Fifteenth Lecture.

1. A simple double acting engine receives steam at 75 lb. gauge and operates condensing with a 24 in. vacuum. The stroke is 48 in., the point of cut-off at 1/5th stroke,, the revolutions per minute of the crank, 95; the diameter of the cylinder bore 30 in. What is its horsepower?

$$P_1 = 75 + 14.7 = 89.7,\ r = 5,\ L = \frac{48}{12} = 4,\ A = \frac{3.1416 \times 30^2}{4} = 706.9$$

$$N = 2 \times 95 = 190$$

$$P_1 \frac{1 + \log_e r}{r} = 89.7 \frac{(1 + \log_e 5)}{5} = \frac{89.7 \times 2.609}{5} = 46.8$$

$$P_b = \frac{30 - 24}{2} = 3 \text{ lb. abs}$$

$$\therefore P = 46.8 - 3 = 43.8$$

$$H.P. = \frac{P\,L\,A\,N}{33000} = \frac{43.8 \times 4 \times 706.9 \times 190}{33000} = 713. \text{ Ans.}$$

2. The above engine has a clearance of 1/9th stroke and the point of compression takes place 5/6th stroke on the return. With this added information compute more accurately the horsepower of the above installation.

$$P_1 = 75 + 14.7 = 89.7,\ L = \frac{48}{12} = 4,\ A = \frac{3.1416 \times 30^2}{4} = 706.9$$

$$c = \frac{48}{9 \times 12} = .44 \quad X = \frac{48}{6 \times 12} = .67,\ l = \frac{48}{5 \times 12} = 0.80$$

$$P_b = \frac{30 - 24}{2} = 3$$

$$E = P_1 (l + c) \left[1 + \log_e \frac{L + c}{l + c} \right]$$

$$= 89.7 (0.80 + 0.44) \left[1 + \log_e \frac{4 + 0.44}{0.80 + 0.44} \right]$$

$$= 89.7 \times 1.24 \left[1 + \log_e \frac{4.44}{1.24} \right] = 89.7 \times 1.24 \times 2.2754 = 252.4$$

$$B = P_b (L - x) = 3 (4.00 - 0.67) = 3 \times 3.33 = 10.00$$
$$C = P_b (x + c) = 3 (0.67 + 0.44) = 3 \times 1.11 = 3.33$$
$$D = P_1 c - P_b (x + c)$$
$$= 89.7 \times 0.44 - 3 (0.67 + 0.44)$$
$$= 89.7 \times 0.44 - 3 \times 1.11 = 39.44 - 3.33 = 36.11$$
$$\therefore B + C + D = 10.00 + 3.33 + 36.11 = 49.44$$
$$\therefore A = 252.40 - 49.44 = 202.96$$

$$H.P. = \frac{P\,L\,A\,N}{33000}$$

$$\frac{202.96\ L\,A\,N}{33000} = \frac{202.96 \times 706.9 \times 190}{33000} = 827. \text{ Ans.}$$

SUMMARY OF PROGRESS IN RECLAMATION.

The following projects have been undertaken by the U. S. Reclamation Service since its inception nine years ago:

Arizona has received	$13,640,000
Colorado has received	9,865,000
Idaho has received	19,719,000
Nebraska-Wyoming have received	10,280,000
Montana has received	15,695,000
Nevada has received	6,380,000
New Mexico has received	10,250,000
North Dakota has received	880,000
Oregon has received	6,060,000
South Dakota has received	3,000,000
Utah has received	2,063,000
Washington has received	11,558,000
Wyoming has received	6,750,000

The act of Congress approved June 17, 1902, known as the "reclamation act," set apart as a fund for the reclamation of arid lands all moneys received from the sale of public lands in certain of the Western States and Territories, excepting the 5 per cent of the proceeds of such sales set aside by law for educational and other purposes. The actual receipts from this source to June 30, 1910, were $65,584,801.32, and the estimated total receipts to June 30, 1911, including $213,998.57 from the sale of town-site lots, are $71,717,-990.16. The net investment of this fund in reclamation works on June 30, 1911, amounted to $60,940,-834.08.

No new projects have been undertaken since March 4, 1909, but prior to that date 32 primary projects had been undertaken, the net investment in which on June 30, 1911, amounted to $59,989,158.46, as is shown in the following table:

NET INVESTMENT IN RECLAMATION PROJECTS TO JUNE 30, 1911.

State and Project	Net Investment
Arizona: Salt River	$ 9,161,437.56
Arizona-California:	
Colorado River	43,659.73
Yuma	4,313,868.21
California: Orland	490,004.53
Colorado	
Grand Valley	83,683.71
Uncompahgre	4,509,697.63
Idaho	
Boise	1,515,525.06
Minidoka	3,741,216.57
Kansas: Garden City	380,030.09
Montana:	
Huntley	853,427.76
Milk River	911,487.99
Sun River	768,493.35
Lower Yellowstone	2,922,442.00
Nebraska-Wyoming: North Platte	5,130,965.75
Nevada: Truckee-Carson	4,103,346.71
New Mexico:	
Carlsbad	571,181.17
Hondo	349,212.20
New Mexico-Texas: Rio Grande	290,746.75
North Dakota: Missouri River pumping	845,471.73
Oklahoma: Cimarron	8,873.17
Oregon:	
Central Oregon	40,416.67
Umatilla	1,206,391.31
Oregon-California: Klamath	1,812,476.07
South Dakota: Bellefourche	2,683,315.01
Utah: Strawberry Valley	1,214,411.90
Washington:	
Okanogan	539,866.49
Yakima	4,905,181.83
Wyoming: Shoshone	3,580,249.28
Total	$59,989,158.46

In addition, there had been invested in secondary projects, June 30, 1911, $586,988.94; in town-site development, $12,997.05; in Indian irrigation (reimbursable), $317,392.23; and for general expenses, $34,297.40, making a grand total of $60,940,834.08. In view

of the immense areas of land included, the magnitude and expense of the engineering work necessary to provide for their reclamation, and of the importance to the waiting settler and land owner that water be applied to the land and reclamation effected as soon as possible, the efforts of the Department have been directed toward the completion of projects already undertaken rather than the search for or undertaking of new projects. The following table contains a summary of the results of the reclamation work from June 30, 1902, to June 30, 1911:

SUMMARY OF RESULTS OF RECLAMATION WORK, JUNE 30, 1902, TO JUNE 30, 1911.

Material excavated	cubic yards		77,118,712
Class 1	cubic yards	67,658,616	
Class 2	cubic yards	5,136,331	
Class 3	cubic yards	1,353,765	
Volume of storage dams	cubic yards		7,192,787
Volume of dikes	cubic yards		3,338,532
Available reservoir capacity	acre feet		1,747,770
Number of tunnels			68
Aggregate length of tunnels	feet		101,365
Canals carrying less than 50 second-feet	miles		1,341
Canals carring from 50 to 300 second-feet	miles		912
Canals carrying from 300 to 800 second-feet	miles		387
Canals carrying more than 800 second-feet	miles		291
Canal structures costing less than $500			22,226
Canal structures costing from $500 to $2000			847
Canal structures costing over $2000			529
Number of bridges			2,223
Aggregate length of bridges	feet		17,310
Riprap	cubic yards		336,056
Paving	square yards		344,891
Cement used	barrels		1,245,827
Concrete	cubic yards		1,066,310
Roads	miles		579
Telephone lines	miles		1,691
Telephones in use			721
Buildings erected			548
Offices		65	
Residences		258	
Barns and storehouses		225	
Area of lands for which water can be supplied	acres		1,025,000
Acreage included in projects now under way			3,101,150

MUNICIPAL ENGINEERING IN CHINA.

BY CONSUL C. L. L. WILLIAMS, SWATOW

There is considerable interest among the local Chinese in municipal improvement. During 1909 and 1910 a new electric-light plant was erected, the work being in charge of Arnhold Karberg & Co., a German firm. The machinery consists of 4 Young's Lancashire boilers, 2 Babcock & Wilcox water-tube boilers, 2 Worthington feed and fire pumps, 1 Cameron (New York) surface condenser, 4 Bellairs & Morcam (Manchester, England) self-lubricating engines, and 4 direct current generators with switchboard (Allgemeine Elektricitats-Gesellschaft, Berlin). The city is wired with mains feeding submains through section boxes. Consumers are supplied with 220 volts and the number of lamps installed at the beginning of 1910 was about 4000. All streets are lighted by 25-candlepower lamps at intervals of about 80 feet. The price to consumers is fixed at 30 cents Mexican (about 13 cents American) on the first 1½ units and 20 cents (8 2/3 cents American) on each succeeding unit per lamp per month.

During 1910 work was started on the local waterworks system. Lee & Orange of Hongkong are the architects for the buildings and MacDonald & Co., also of Hongkong, are the engineers. The water will be taken from the River Han, about 10 miles above Swatow. The pumping and filtering plant will be at the intake and will consist of 4 settling tanks, each of 1,200,000 gallons capacity, 4 filter beds, each of 200,000 gallons capacity, 1 covered-in service reservoir of 800,000 gallons capacity, and the engines, boilers and pumps. The main from the intake station to Swatow will be a 12-inch cast-iron pipe, about 6¾ miles long, and the quantity of water delivered at Swatow 3.33 cubic feet per second. At Swatow will be a water tower from which the street mains will be supplied. The cost of the work is estimated at $325,500 gold. However, owing to unsettled conditions in China, the construction of the works is indefinitely postponed.

Had there been any American engineering firms on the spot when these projects were mooted it is quite possible that they could have received some share. When it is remembered that the Chinese promotors of these undertakings are without technical knowledge, it is obvious that no engineering firm can hope to secure such work through correspondence.

American firms desiring to enter the field in South China should make their headquarters at Hongkong, from where all southern outports are easily covered as occasion requires.

LOW POWER RATES IN URUGUAY.

The President of Uruguay, in an official decree, calls attention to his proposition to establish State control and centralized management of all the electric plants in the republic, and lays down the following reduced tariff per kilowatt-hour for electricity for power and heating: Up to 1000, 5½ cents; 1000 to 2000, 4 cents; 2000 to 3000, 3 cents; more than 3000 2 cents.

While it is estimated that this reduction in tariff will result in a decrease in the gross earnings of the Usina Electrica of Montevideo of some 43,000 pesos ($44,462), it is believed that the plant can still be run at a profit. This reduction in the cost of electricity in Montevideo makes the rate in this city in general the lowest of any municipality in South America.

LOS ANGELES AQUEDUCT HYDROELECTRIC PROJECT.

The city of Los Angeles has recently approved a bond issue amounting to $357,367 to complete the equipment of the hydroelectric project to be operated in connection with the 250 mile aqueduct by which the city water is brought from Owens Lake near the Yosemite National Park.

The generating equipment will be installed at Power House No. 1 located at San Francisquito, 47 miles from Los Angeles, to which point current is sent at 60,000 volts.

In the power house, there will be installed three 9375 k.v.a., 6600 volt, 50 cycle, three-phase water wheel generators running at 200 r.p.m.; and two 250 k.w., 250 volt direct current water wheel generators used as exciters; ten 3150 k.v.a., single-phase, 50 cycle oil insulated water cooled transformers for raising the generator voltage (6600) to that of the transmission, 60,000.

In the substation there will be installed nine 5000 k.v.a. single phase, oil insulated water cooled transformers for stepping down the transmission voltage to either 33,000 or 15,000 for secondary distribution. The contract for the entire equipment was awarded to the Westinghouse Electric & Manufacturing Company.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly

FOUNDED 1887 AS THE
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CONTENTS

Great Western Power Company Announcement

The announcement of the Great Western Power Company, found in our last issue, is of interest to the electrical fraternity on the Coast. The continual development of enormous western water powers shows the implicit confidence held in high financial circles regarding the substantial growth of our western empire. Needless is it to say, that this confidence is not misplaced.

A careful study of the growth of our nation during the past decade fully emphasizes the section of our country, for which the future has most in store.

The reclamation projects of the future must largely look to the pumping of water in the solution of their distributing systems. The power supply required, although economic in unit reclamation, when totaled for the millions of acres susceptible to irrigation will unquestionably utilize every available source of hydroelectric energy capable of reasonable development in the West.

Polar Co-ordinates

Much confusion has always befogged the reader's mind when attempting to compute instantaneous values in alternating electric circuits. The ordinary sine wave if plotted to scale shows to the eye how instantaneous values may be combined when two or more are impressed upon the same circuit.

Alternating currents are, however, measured in effective values instead of instantaneous values. That is, the square root of the sum of the squares of the instantaneous values is taken as the true value, in practice. A reading in alternating current units indicates the amount of alternating current, for instance, which would be necessary in the heating of a wire the same amount that a direct current of the same value would accomplish.

The polar co-ordinate, while receiving some attention from engineers, has been mostly relegated to the back-ground, due to the fact that it has always been thought it could not be used for instantaneous values. Elsewhere in these columns will be found an article by Mr. A. L. Menzin on the Graphical Analysis of Alternating Current Phenomena. Mr. Menzin by means of very simple illustrations brings out the ease with which not only maximum or even effective values in alternating currents are correctly shown on the polar graph but in fact, instantaneous values are also shown in remarkably lucid form. A deeper study into polar co-ordinate representation will unquestionably bear much fruit in the further clearifying of the graphical picturing of complicated alternating current phenomena.

Apathy of California in Reclamation

Elsewhere in these columns will be found a summary of the reclamation projects which have been undertaken by the Federal Government and also will be found the net progress in expenditure and accomplishment which has been made.

A careful analysis of this summary shows a most surprising condition of affairs. The great commonwealth of California, the second in size in the Union, known the world over for its irrigation enterprise and

advance, stands awkwardly alone at the foot of the column. It is indeed true that a first glance at the tabulation shows somewhat more favorably for California by counting as California enterprises the Oregon-California and Arizona-California projects. Analyzing these two projects, however, we find that both, so far as the California side of the undertaking is concerned, will total less expenditure than $250,000. The sole undertaking which may be credited to California is that of the so-called Orland project, which totals $620,000 in all and which shows a net expenditure to date of $490,004.53.

The cause for such discrepancy is solely due to the apathy of California citizens. Attend the National Irrigation Congress if you will, and contrast the attendance and vital interest of other states to the cold indifference of California as shown in her usual half dozen delegates.

Montana, one of the sparsely settled states in the Union, has secured favorable action on over $15,000,000 in reclamation appropriations. California, accustomed to parade its irrigation prowess to the world, secures $620,000. No one can visit the arid lands of central California or even the sun-lit deserts of the southern portion of the state, without seeing in this beautiful stretch of fertile soil, a possibility of reclaiming a million and a half acres of land. Such enterprises are beyond the scope of private capital, as national funds are necessary for liquidating such vast expenditures.

The enterprise and energy of the great "poppy state" should for one season be devoted to promotion of some of her best arid land projects. No one reclamation enterprise hitherto undertaken for other states should be jeopardized or cut down in appropriation, but immediate steps should be taken by that great commonwealth to see to it that a reasonable appropriation be expended in her behalf to assist in the development of her vast arid kingdom.

Engineering Opportunities in China

The burning of forty maidens, pure and undefiled, at the funeral pyre of Jenghis Khan to satisfy the morbid passions of the world's greatest human scourge, who in the thirteenth century came forth from the wilds of Mongolia and nearly swept European life from the face of the earth, is a frightful illustration of what Chinese civilization has been to the human race.

The invention of powder, the manufacture of glass, the art of printing, and nearly all the other great triumphs of modern advance are claimed by the Chinese so far as priority of invention is concerned, and yet to what useless and inferior applications have they put these great forces of modern progress.

Two hundred and fifty million human hearts, a number in magnitude almost beyond conception, throb and pulsate in the "great flowery kingdom," and yet stagnation has so enthralled its people that to review the inferior progress such vast numbers have made affords a striking picture to the thinking mind. With this enormous population, however, and with undeveloped resources, inconceivable in their gigantic proportions, the Chinese Empire presents today the greatest field for rapid industrial growth and internal development of any nation on earth.

Those of us who have, day by day, followed the progress of affairs in China, cannot help but be impressed with the contents of the manifesto issued by President Sun Yat Sen at Shanghai under date of January 5th last. China has in the past had her revolutions, slaughtered her millions, only to sink again into lethargy and stagnation. The revolution of today, nevertheless, seems to be so impregnated, so permeated through and through with western ideas and civilization that the careful student following the trend of recent events can but see in this uprising a tendency toward an immediate and complete upheaval of old ideas and an installation of the new. Indeed, it is stated in the republican manifesto, above alluded to, that if the revolution succeeds, it "will remodel the laws, revise the civil, criminal, commercial and mining codes, reform the finances, abolish the restrictions on trade and commerce, and insure the development of better relations with foreign peoples than have ever been maintained before." Continuing further it states that the supporters of the republic cherish the hope of co-operating in the great and noble task of building up the civilization of the world, and they put themselves on record as stating that the Manchus have retarded the creation of industrial enterprise and rendered impossible the development of natural resources.

The cueless Chinaman of the future presents a picturesque yet impressive figure. It seems that the leaders of the struggle for the establishment of a republic are largely those who have received their education among the foreign nations of the world. Secret orders have been maintained by them for the past twenty years for the sole purpose of protecting their ideas throughout the civil, military, and commercial life of the empire. How successful they have been in their silent work is daily unfolded in the continued and successful progress of the Chinese insurrection.

Especially for the engineer of our West, the opportunities now soon to be afforded in the awakening of China are unparalleled in history. The remitting of the Boxer indemnity by the United States has offered an opportunity for using this money by the Chinese officials to educate their most brilliant young men. This award, in fact, was set aside by the Chinese Government and devoted for educational purposes. Thousands of their young men have entered the educational institutions of the United States, and especially have the colleges and universities of our western coast been patronized most generously.

Follow the news of the day, and many of the names set forth as leaders in the present upheaval, from cabinet officers down, will be found in the list of graduates or former students of the University of California, Leland Stanford Jr. and other western institutions. Even now these young men have in contemplation the introduction of our methods in the remodeling of Chinese engineering growth.

Our Pacific ports turn with outstretched arms toward the Orient. Commercial bodies as well as our western engineers should be alive to the immediate opportunities to be found. In the acting, then, of the Oriental engineering drama immediately ahead, let us be alert and take as our entering cue into the land of the celestials the nation-wide abandonment of this time-honored hair appendage.

PERSONALS.

M. C. Lord has been made engineer and sales manager for David Dow & Son, of Seattle, Washington.

R. D. Holabird, president of the Holabird-Reynolds Company, has returned to San Francisco after visiting Los Angeles.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, has been at Los Angeles during the past week.

Benj. J. Weeks, commissioner of light and power, Seattle, has resigned. Mr. Weeks gives as his reason his dislike for politics.

B. C. Carroll, general agent of the Pacific Telephone & Telegraph Company, is making an extensive trip through the Northwest.

L. H. Gardner, of the code department of the Western Union Telegraph Company, has arrived at San Francisco, from New York, on a tour of the Pacific Coast.

A. L. Rogers of Waterville, Wash., a regent of the State University, has declined the offer of a position on the Public Utilities Commission of the State of Washington..

A. J. Myers, district manager of the Wagner Electric Manufacturing Company, is at Los Angeles on his return trip after attending the annual managers' meeting at St. Louis.

William Clayton, who acts as general manager of John D. Spreckels' interests at San Diego, including the San Diego Electric Railway system, was a recent San Francisco visitor.

H. F. Gronen, the project engineer of the Seattle municipal ownership company, will assume, until April, the duties of commissioner of light and power made vacant by B. J. Weeks.

F. E. Trask, consulting civil and hydraulic engineer of Los Angeles, has removed his offices from rooms 421-425 Homer Laughlin Building, to rooms 616-624 Union Oil Building.

C. O. Poole of Manifold & Poole, the Los Angeles electrical engineers who have supervision of the Southern Sierras Power Company's new development, is at San Francisco on hydroelectric business.

Ralph L. Phelps, Pacific Coast manager for the Safety Insulated Wire & Cable Company, is expected to return to his office at San Francisco about February 20, after spending a month at New York.

Garnett Young, general manager of the Telephone-Electric Equipment Company, has returned to San Francisco from Southern California, where he spent a week in visiting the Los Angeles office, of which R. J. McHugh is manager.

J. Q. Brown, chief engineer and purchasing agent of the Oakland Railway Company, has returned to Oakland after completing an extensive Eastern trip in the course of which he visited the leading factories.

R. F. Oakes, president of the American Ever Ready Company, with headquarters at Factory No. 8, San Francisco, will motor down to Del Monte on Saturday, February 17, with his family and will remain over for the Electrical Jobbers' golf tournament, opening February 22.

F. E. Blanchfield, who was formerly Northwest sales-manager for the American Ever Ready Company, has been appointed sales manager at San Francisco, under president R. F. Oakes of the Pacific Coast department.

R. B. Dougall, who was for eleven years connected with Paul Seiler & Co., has joined the sales force of the Pacific States Electric Company. M. L. Scobie, formerly of Chicago, has also joined the sales department of this house.

Rex T. Stafford, who has been connected with the San Francisco office of the Allis-Chalmers Company for several months past, left for Puget Sound last Sunday, with his family, and will, in the future, be one of the salesmen in the electrical department at the Seattle office.

Joseph Blethen, manager of the Seattle Daily Times, and president of the Seattle Carnival Association, was the guest of honor of the Jovian Electrical League at their Seattle luncheon, on February 8th, at the Butler Hotel.

H. V. Carter, president of the Pacific States Electric Company, has just returned from the Northwest. Mr. Carter reports that prospects through this promising territory are most encouraging. Business men are optimistic and the outlook for a successful season was never of a brighter hue.

L. R. Wiley, a hydroelectric engineer who has been identified for several years with Tuolumne county power enterprises, which are now controlled by John Hays Hammond, is at San Francisco, after spending some time in the East on business connected with power sites in Northern California.

Wynn Meredith, Pacific Coast manager, and Francis Blossom, a member of the firm of Sanderson & Porter, of New York, arrived at San Francisco from the Northwest last Saturday. Mr. Blossom leaves this week for the East and expects to stop over at Los Angeles and Trinidad, Colorado.

H. W. Clapp has been appointed assistant electrical engineer of the Southern Pacific Company under A. H. Babcock, the chief electrical engineer. Mr. Clapp has had charge of the electrical construction work on the company's local lines in Alameda county, which have been electrified during the past year.

Theodore B. Comstock, secretary and chief engineer of the Board of Public Utilities in Los Angeles, will soon retire from the position and will be succeeded temporarily at least by Thomas Foulke, a member of the board. The probabilities are that Charles E. Warner, at the present time investigating the aqueduct, will finally occupy the position.

R. S. Buck, the member of the firm of Sanderson & Porter who managed the construction of the Stanislaus plant, will arrive at San Francisco, Feb. 20, to remain permanently. Buck's presence is necessary on account of increase of activities in the West. Mr. Buck, together with Wynn Meredith, will constitute two members of the firm of Sanderson & Porter, with permanent headquarters at San Francisco.

Clarence F. Clewell, who for the last two years has been in charge of the design and installation of the extensive lighting work at East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company, has recently been transferred to the sales department of the electric company and is now engaged in illuminating engineering work in connection with detail and supply department.

Geo. E. Dow, general manager of the Geo. A. Dow Pumping Engine Company, left San Francisco this week for an extensive European trip during which he will be accompanied by an engineer thoroughly familiar with the Diesel engine. Mr. Dow proposes to manufacture these engines on the Pacific Coast. Now that the Panama Canal is nearing completion San Francisco is destined to be a great manufacturing center as well as a consumer of manufactured articles.

J. W. Churchill, president, and J. P. Churchill, vice-president of the California and Oregon Power Company, which has just taken over the Rogue River Power Company, the Siskiyou Electric Power and Light Company and a number of other power plants in the two states, have been spending a few days at San Francisco. They are closing contracts for the first generating unit for their new development on the lower Klamath river, which has an ultimate capacity of about 100,000 kw.

W. H. Storms, the recently appointed California State Mineralogist, is now collecting data relative to mineral production for 1911, as required by law. The result of this work, published in an annual report, helps greatly in advancing the varied mineral interests of the State. The greater part of the information required is obtained by corresponding with the owners and operators of mineral property. Many

in this locality probably have received inquiry blanks from the State Mining Bureau regarding the output and progress of work in the year 1911. Those who have received such, are urged to answer them at once.

ELECTRICAL CONTRACTORS' NOTES.

T. C. Hobreck, secretary of Sacramento Local No. 3, was at San Francisco on business during the past week.

Paul Butte, of the Butte Engineering and Electric Company, will make a trip to the Pacific Northwest during the coming week.

The office of the secretary of the California State Association of Electrical Contractors has been moved to Room 1408, Metropolis Bank building.

W. S. Hanbridge, secretary of the Electrical Contractors' Association, spent Monday in Palo Alto and San Mateo looking after the contractors' interests.

Hetty Bros. have removed their electrical supply house from 357 Ellis street to 372 Ellis street, their permanent quarters at San Francisco.

The Joshua Hendy Company has secured a contract for ornamental cast-iron electric light posts for use at San Jose where a development league has arranged for better illumination of certain business streets.

Lange & Bergstrom have been awarded the contract for putting up the new building for the Sharon Estate on the corner of New Montgomery, Jessie and Stevenson streets. The sub-contracts will be let in a few days. The entire ground floor has been leased to the General Contractors' Association and it is probable that this fine office building will be the official home of most of the building contractors.

IN MEMORIAM.

Arthur W. Ballard, president and general manager of the Pacific Gas & Electric Company of Phoenix, Arizona, died in that city on February 8th from a self-inflicted gunshot wound. Mr. Ballard had suffered great pain during the past few months and had been dreading a necessary operation for gall-stones, and it is believed that the ensuing despondency caused the act.

Mr. Ballard was 43 years of age, a native of London, England, coming to America with his parents in 1870. He received his education in Canada and came to the Pacific Coast in the early '90s, where he entered the employ of the General Electric Company, later being made manager of the company's Los Angeles office. After twenty years' service with the General Electric Company Mr. Ballard resigned his position about two years ago to look after his private interests.

At the time of his death Mr. Ballard was president of the Pacific Gas & Electric Company, Alhambra Brick and Tile Company and Phoenix Machine and Cold Storage Company, all of Phoenix, Arizona, and the Santa Maria Gas & Electric Company. He had investments in several other large corporations. He was a member of many prominent clubs and a man of remarkable executive and business ability and possessed the charm of a personal magnetism and buoyant disposition which won for him the abiding friendship of a host of prominent men throughout the cities and towns of the Pacific Coast.

SAN FRANCISCO SECTION A. I. E. E.

An interesting meeting of the San Francisco Section of the A. I. E. E. is in store for the members at the next meeting, Friday evening, February 23, Home Telephone Building. Sam L. Naphtaly, general manager of the Great Western Power Company, will present a paper on the recent submarine cable crossing of San Francisco Bay, the first successful submarine power cable to transmit hydroelectric power into San Francisco.

N. E. L. A. NEWS.

The Residence Business Committee of the Commercial Section of the National Electric Light Association met for its second meeting on January 15th and 16th. The meeting was attended by Messrs. J. F. Becker, chairman; G. B. Griffin, E. A. Norman, G. C. Osborne, F. D. Pembleton and N. E. Boynton, secretary. This committee has taken upon itself the very important work of compiling data, information and literature which will assist central station companies to increase their residence business and to make it more profitable to them. In the search for accurate data each member of the committee is doing personal work, they are also soliciting the assistance of all central station companies. This publication is to be a 24-page and cover 3x6 booklet which many central stations will use in their campaign for residence business.

PORTLAND SECTION OF N. E. L. A.

Over 100 members of the National Electric Light Association employed by the various public service corporations having headquarters in Portland, Oregon, have organized the Portland Section of the N. E. L. A. The following companies are represented: Portland Railway, Light & Power Company, Pacific Power & Light Company, Mt. Hood Railway & Power Company, General Electric Company and Westinghouse Electric & Manufacturing Company.

The first regular meeting of the Portland Section was held in the Auditorium of the Electric Building on Tuesday evening, February 6. At that time, Mr. S. G. McMeen, recently elected president of the Mt. Hood Railway & Power Company, addressed the section on the subject of "A Few Fundamentals." Mr. McMeen's talk was intensely interesting and portrayed the personal side of a number of prominent scientists and inventors. After his address the Section was entertained by a number of amateur entertainers, music being furnished by the Electric Club orchestra.

The officers of the Portland Section are: Chairman, A. S. Moody, General Electric Company; Vice-Chairman, A. C. McMicken, Portland Railway, Light & Power Company; Secretary, Lewis A. McArthur, Pacific Power & Light Company; Treasurer, R. S. Carroll, Portland Railway, Light & Power Company; Executive Committee, C. E. Groesbeck, H. M. [illegible] & Co.; O. B. Coldwell and C. C. Turlay, Portland Railway, Light & Power Company.

ELECTRICAL SUPPLY JOBBERS' ASSN. MEETING

The Electrical Supply Jobbers' Association of the Pacific Coast is about to hold a convention at Hotel Del Monte on February 22, 23 and 24, 1912.

BOOK REVIEW.

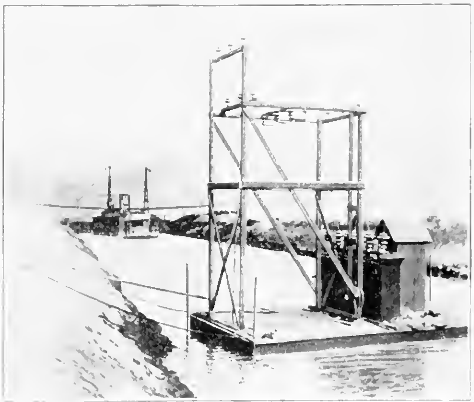
Mill and Factory Wiring. Electrical installation manuals. By [illegible]. By J. H. Johnson, A. M. I. E. E. Size 4x6½ inches; 135 pages; illustrated; clear type; strong paper; durable cloth binding. Published by D. Van Nostrand Co., of New York and for sale by Technical Book Shop, 106 Rialto Bldg., San Francisco. Price Seventy-five cents.

This book contains nine chapters which cover a discussion of the reflective power of substances, open arc lamps, enclosed arc lamps, Crompton-Blondel flare lamps, excello flame lamps, illumination requirements of various industries, and current for bioscope lamps. An illustration in cross-section is shown for each characteristic lamp and a description of [illegible] working principles follows in simple style. Many [illegible] given for the proper installation and use of [illegible] together with its accessories. The discussion on [illegible] suspension and switchgear is interesting and [illegible] which coupled with the useful tables to be found the [illegible] on pertinent data make it of much practical value.

INDUSTRIAL

HIGH VOLTAGE OUTDOOR TRANSFORMERS.

There is a steady and growing demand in small towns, and in various small industrial plants located near high voltage transmission lines, for outdoor transformers to distribute electric power directly from the high voltage line. This demand has led to the development of high voltage outdoor transformers, which is one of the comparatively recent ad-



40 k.v.a. single-phase 50-cycle 33,000-22,000-volt Outdoor Transformer installed on float for operating dredges used in the construction of the Los Angeles Aqueduct.

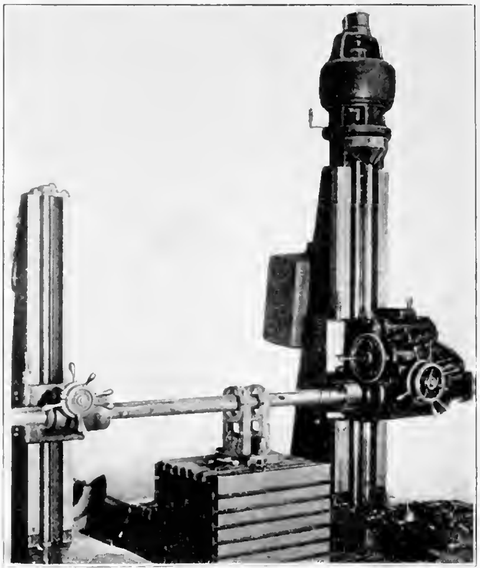
vances in transformer design. There are a great many places where a small amount of power can be sold and yet where it is not economically feasible to install a substation. What is required is a transformer that can be mounted on a platform in any convenient manner, and connected to the transmission line without any provision for protection from the weather.

An interesting installation of outdoor type transformers is shown above, which illustrates three 40 k.v.a. single-phase transformers installed on a float for three-phase service. These transformers were used in the construction of the Los Angeles Aqueduct. This method was found very convenient as the float was readily towed from place to place and anchored as the work progressed. Connections were made to an adjacent high tension line and the voltage was stepped down for use on an electrically operated dredge.

VERTICAL MOTOR DRIVE FOR BORING MACHINE.

By the use of individual electric drive, the machines may be located in the most convenient places for the work they are to perform, rather than in a row and driven from one line shaft. The economy and flexibility of individual motor drive cannot be too greatly emphasized, since this form of furnishing power has been largely responsible for the increased output of many varied industries.

A particularly interesting and somewhat unique example of the manifold advantages of individual motor drive, applied to machine tools, is shown by the accompanying illustration. This horizontal boring machine is built by the Rochester Machine Tool Company of Rochester, New York. The motor is a 5 h.p. vertical type R, made by the Westinghouse Electric & Manufacturing Company of East Pittsburg, Pa. The method of mounting the motor on the top of the column, as

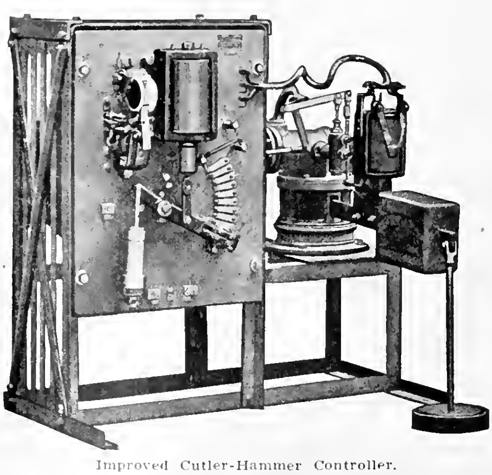


Rochester Horizontal Boring Machine Driven by a 5 H.P. Type R Westinghouse Vertical Motor.

illustrated, has proved particularly satisfactory in securing maximum efficiency and it has been surprising to many that motors of such small capacity should prove ample for the heavy work accomplished.

NEW CUTLER-HAMMER CONTROLLER SOLVES HYDRAULIC ELEVATOR PUMP PROBLEM.

Central stations to have considerable power loads must have power engineers who make thorough surveys and careful calculations of electric power applications. Mr. J. C. Par-



Improved Cutler-Hammer Controller.

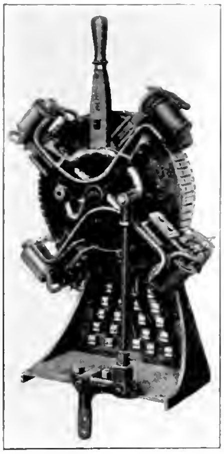
ker, electrical and mechanical engineer of the Rochester Railway & Light Company, has an engineering force that has built up a motor load that is typical of what can be done by the right methods. Every effort is made to give the customer an equipment which will be economical in current consumption, have low peak demands and be at the same time profitable to the company.

The case of a customer using a motor to drive a rotary screw pump on an hydraulic elevator system is a recent example of this company's methods. The outfit in use was noisy, not competent to maintain sufficient pressure during the rush hours of the day and being of low efficiency caused a light power consumption. The problem was similar to two others that had been previously solved by the engineers of the company.

A triplex pump in this case was substituted delivering 200 gallons per minute and was driven by a 13 h.p. 220 volt variable speed motor. The controller, furnished by The Cutler-Hammer Manufacturing Company of Milwaukee and illustrated herewith regulates the motor automatically so that when the elevator service is light, the pump is run at its slowest speed, but as service grows heavier, the motor speed is increased automatically by the controller and more water is pumped to meet the demand. The customer is saving $600 per year, which is 40 per cent of the cost of the new controller, pump and motor. The power rate is better because the controller maintains a uniformly tank pressure and sudden and high current demands do not occur. The controller used in this case is of different construction than the standard line having the regulating resistance mounted on the back and the automatic starter on the front of the panel, making it very compact.

A NEW CRANE CONTROLLER.

The well known "grindstone" type of controller used extensively in connection with direct-current motors operating cranes, hoists, steel mill machinery, etc., has proven eminently satisfactory. It has recently undergone a refinement, however, which will still further increase its value by simplifying its construction and increasing its durability.



Improved Crane Controller.

As shown in the illustration, the controller consists essentially of a cast iron frame on which is mounted a stationary disc carrying the contact pieces and cross connections. Pivoted to the center of the disc is the switch arm with four brushholders. The resistors can either be mounted on the frame or separate.

As a result of a series of experiments, the Westinghouse Electric & Manufacturing Company has recently placed on the market controllers of this type in which the disc is made of concrete instead of stone.

Fig. 1 shows the front view of the new concrete "grindstone" controller. In this particular piece of apparatus the resistors are separate and not shown. The contact pieces are attached to the disc by screws in the same way as in the older type, and are as easily removable. A blowout coil of asbestos insulated wire is mounted on each brushholder to disrupt the arc form d in opening circuits.

H. W. JOHNS-MANVILLE COMPANY SOLE SELLING AGENTS FOR I. P. FRINK REFLECTORS AND ILLUMINATING SPECIALTIES.

The H. W. Johns-Mansville Company, already well known in the lighting field by reason of their J-M Linolite System of illumination, have acquired the sole selling agency for the entire products of I. P. Frink.

"Frink" reflectors and fixtures need no introduction to the lighting trade and consumers throughout the country, and this arrangement means that the H. W. Johns-Manville Company will be in position to design and sell lighting systems for every known form of artificial illumination.

An engineering department will be maintained along very extensive lines. This department will maintain a corps of engineers throughout the United States and Canada, and be equipped to place data and recommendations in the hands of all interested in any subject pertaining to illumination.

TRADE NOTES.

The Ohio Brass Company of Mansfield, Ohio, has distributed during the past month their attractive Bulletin No. 1, of Vol. 7, which is devoted to electric railway and mine haulage material.

The General Electric Company has sold to the Honolulu Rapid Transit Company, for its traction lines in the Hawaiian Islands, 13 G. E. 218 two-motor car equipments with K. 36 controllers.

The Fort Wayne Electric Works have sold to the Southern Sierras Power Company 48 distribution transformers of the outdoor type, for use in connection with a 30,000-volt transmission line.

The National Conduit & Cable Company of New York has added to their various departments a large brass foundry under special laboratory supervision, for making high class castings of all description.

The Seattle, Renton & Southern Railway Company has placed an order with the Westinghouse Electric & Manufacturing Company for six double equipments of Number 317 Motors with type HL, U.S.G. control.

On February 1st the Westinghouse Air Brake & Traction Company, will remove the office of their Southeastern manager, Mr. E. A. Craig, from the General Office, Wilmerding, Pa., to 308 Westinghouse Building, Pittsburg, Pa.

One of the great electric traction systems of the south, the Piedmont and Northern Lines, is about to enter the telephone train dispatching field, and with this end in view has placed orders with the Western Electric Company for equipment to be used on two of its lines.

The Stewart-Fuller Company have moved their office and warerooms from 143 Second street to 40 Stevenson street, San Francisco, in addition to carrying a stock of Vulcan soldering irons, curling irons and flat irons, Nokorode soldering paste, and Peirce expansion bolts, they are also agents for underground clay conduit and Peirce line material for telephone and power work.

The Westinghouse Electric and Manufacturing Company has sold to the East Shore and Suburban Railway Company one 1500-kw. motor-generator set, which is to be installed in the present substation at Richmond. This will provide additional direct current capacity for the operation of trolley cars.

The Telephone-Electric Equipment Company, Pacific Coast sales agents, announce a new non-metallic flexible conduit placed on the market by the National Metal Molding Company of Pittsburgh. The name of this new product is Flextube, a continuous circular tubing constructed from specially prepared rigid fibre wood, formed into a helix, and interwoven with warp. There are no separable parts. The result is a very closely woven inner tube, securely held in circular form, and this surface is soapstoned to give added smoothness. This will be manufactured in the 2-8 in. and 5-16 in. as well as in the 3-8 in. size.

NEW CATALOGUES.

The Steel City Electric Company of Pittsburg, Pa., is distributing a pamphlet entitled "Steel City," which sets forth steel outlet boxes of various designs.

The Steel City Electric Company of Pittsburg is distributing Bulletin E describing Fullman adjustable watertight floor outlets. A partial list of buildings equipped with Fullman outlets is enclosed.

The Brill Magazine for January has a neatly illustrated article on conditions which govern car service in Vienna, Austria, and will be found interesting to those engaged in city street car development.

The National Tube Company of Pittsburg has just published a correction sheet No. 4 for Catalog H of 1909. This sheet includes all corrections previously incorporated in correction sheets Nos 1, 2 and 3A.

The Union Iron Works Company of San Francisco is distributing Catalog No. 5 which deals with Evans hydraulic elevators and hydraulic mining machinery. The booklet is neatly illustrated with installations made by the company and describes parts connected with their hydraulic and mining equipment offered to the trade.

The Sprague Electric Works of the General Electric Company has just issued Bulletin No. 239 on full automatic push button control systems for the operation of newspaper presses. The booklet will be found interesting and profitable reading to those in any way engaged in improving economy in the operation of the printing press.

George J. Henry, Jr., hydraulic and mechanical designing and constructing engineer, of San Francisco, has just distributed an interesting and attractive pamphlet on "Water Power." The pamphlet sets forth the economic and efficient development and use of water power for hydroelectric transmission and for mining and industrial purposes.

"Warren Beautiful" is the title of a handsomely illustrated publication of thirty-six pages put forth by the Sterling Electrical Manufacturing Company of Warren, Ohio. The paper prepared by J. Robert Crouse interestingly details the advantages of a city, the first to adopt the mazda street lighting to the exclusion of all other street lighting methods.

The Simonds Machinery Company of San Francisco is distributing hand book and Catalog No. 7 of the Kewanee Water Supply Company, Kewanee, Ill. The booklet is handsomely illustrated and ably sets forth recent development in water supply and is of interest to those engaged in improving their present apparatus for this branch of the mechanic art.

G. A. Wilbur, electrical manufacturer's agent of San Francisco, is distributing Bulletin No. 22 of the Duncan Electric Manufacturing Company. The bulletin sets forth the features of Duncan Type Model R watthour meters wherein no magnetic shields are needed, no iron is utilized in the armature, and the meter accuracy is not impaired by short circuits.

The Westinghouse Electric & Manufacturing Company has issued Descriptive Leaflet No. 2298 describing its well-known type CCE induction motor. The company has also just issued Leaflet No. 2330 covering a direct current (Type JL) vertical edgewise switchboard ammeter operating on the D'Arsonval principle with a single air-gap.

The Simonds Machinery Company of San Francisco is distributing Catalog No. 18 of the American Steam Pump Company, Battle Creek, Mich. The catalog is profusely illustrated. It details in a systematic and clear manner the various designs of pumps offered by them which covers the entire field wherein a pump is used for any purpose whatsoever.

NEW CATALOGS PUBLISHED BY THE GENERAL ELECTRIC COMPANY.

Bulletin No. 4917 illustrates and describes direct current exciter panels. Bulletin No. 4893 is devoted to a general description of two automatic time switches. Bulletin No. 4901 is devoted to alternating current switchboard panels with oil switches attached. Bulletin No. 4906 is devoted to the lighting of textile mills and in this connection considers those items briefly. The publication is enclosed in a rather striking cover. Bulletin No. 4904 illustrates and describes three-phase panels for use in small or isolated plants containing but one generator. Bulletin No. 4905 is devoted to panels designed for general use in small central stations and isolated plants. Bulletin No. 4921 describes the Thomson prepayment watthour meters for direct and alternating current, Types CP-4 and IP-4. Bulletin No. 4918 illustrates and describes panels designed for general use in central stations. Small plant direct current switchboards is the title of Bulletin No. 4919. The bulletin is devoted to a description of panels which are designed for the control of three-wire generators. Bulletin No. 4920 describes the GE-203A railway motor which is of the box frame, commutating pole type, rated at 50 h.p. on 600 volts and 40 h.p. on 500 volts. Bulletin No. 4887 is an attractive bulletin illustrating and describing the General Electric Company's turbo-generator sets in capacities of from 5 to 300 kw. Bulletin No. 4900 is devoted to apparatus used in connection with series incandescent street lighting, and supersedes in part the company's previous bulletin on this subject. Bulletin No. 4907 recently issued by the General Electric Company contains interesting data relative to the lighting of offices, banks and public buildings by G. E. Edison mazda lamps.

NEW PUBLICATIONS—BUREAU OF MINES.

Bulletin:—Bulletin 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with an introduction by C. E. Munroe, and a chapter on the natural gas used at Pittsburgh, by G. A. Burrell. 1911. 197 pp., 7 pls.

Technical Papers:—Technical Paper 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1911. 22 pp. Technical Paper 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1911. 19 pp.

Reprints:—Bulletin 31:—Incidental problems in gas-producer tests, by R. H. Fernald, C. D. Smith, J. K. Clement, and H. A. Grine. 29 pp. Reprint of United States Geological Survey Bulletin 392. Copies will not be sent to persons who received Bulletin 392. Bulletin 32. Commercial deductions from comparisons of gasoline and alcohol tests on internal combustion engines, by R. M. Strong. 38 pp. Bulletin 33. Comparative tests of run-of-mine and briquetted coal on the torpedo boat Biddle, by W. T. Ray and Henry Kreisinger. 49 pp. Reprint of United States Geological Survey Bulletin 412. Copies will not be sent to persons who received Bulletin 412.

NEWS NOTES

SPECIAL CORRESPONDENCE.

SEATTLE, WASH.—The final hearing by the State to determine the valuation of the Pacific Telephone & Telegraph Company's property in the State of Washington, brought out the fact that this company pays to the American Telephone & Telegraph Company 4½ per cent of its earnings, or approximately $10,000. The commission is to investigate this charge as it is believed to be excessive. Edgar S. Bloom, New York, in charge of plant operation of the American Telephone & Telegraph Company; H. D. Pillsbury, general counsel; A. H. Griswald, plant engineer, and O. W. Berkett, general superintendent of the Pacific Telephone & Telegraph Company, were present at the meeting concerning the fear of the City Council that the public service commission is trying to assume jurisdiction over municipal plants. Commissioner G. A. Lee said that there is no ground for fear. The commission can not and does not want to control municipal plants but, simply wishes to act in conjunction with them for the good of all.

All companies operating on Puget Sound under the management of Stone & Webster have consolidated under the name of the Puget Sound Traction, Light & Power Company. A certificate of organization has been filed, naming Portland, Me., as the headquarters of the company, and Richard T. Laffin of Seattle, general manager. The trustees are Chas. M. Drummond, president; Wadleigh B. Drummond, secretary and treasurer, and Josiah H. Drummond.

The commissioners refused the Puget Sound Electric Company a franchise to set poles and string wires along the county road between Orillia and Auburn. About 200 property owners, offended by the rise in transportation rates of the company, protested against granting the franchise.

The foreman of the pile driving gang, on the bulkhead of the Twelfth avenue South bridge was electrocuted by a water soaked pile touching the high tension wires of the Snoqualamie Power Company. Several others were knocked down but not badly hurt.

An inspector of the local gas company discovered a pipe not connected with the meter in a lodging house, run by Mrs. Ida M. Anderson, and suspecting larceny of gas so reported to the company. The gas company immediately shut off the service connection and brought a criminal charge against Mrs. Anderson. She was acquitted of the charge and brought suit for damages to business against the company and was awarded $250 by the jury.

Interests represented by Sanderson & Porter have taken over the franchise and property of the South Bend-Raymond Electric Company. The consideration is said to be $100,000.

The Seattle Electric Company's report to the commission shows that during 1911 there were 71,180,189 fares rung up, while 4,198,107 employees and others were carried free. The average fare was 4.8 cents. The passenger revenue was $3,425,380.07, freight $87,581, and the mail contract $10,275. Ten people were killed and 3492 injured; $211,872 or 6½ per cent of the operating expenses, was paid for injuries and damages. The operating expense was 70.58 per cent of the operating revenue.

PORTLAND, ORE.—There is much dissatisfaction over the January bills of the Hood River Gas & Electric Company at Hood River, as they are about 300 per cent higher than ever before. The company is trying to get the consumers to take a flat rate contract for one year. They promise to annul the January bill and date the year's contract from January 1, 1912. About 100 consumers have gone over to the hydro-electric company.

A new telephone line to be known as the Mutual Telephone Company, is to run from Seaside to Elk Creek river, a distance of nine miles. The new line will have long distance connections with the Pacific States Telephone & Telegraph Company.

Vancouver, Wash., is being entertained by a newspaper controversy between the Portland Railway, Light & Power Company and the Washington-Oregon Corporation relative to the merits of electric arc light and gas arcs for street lighting. The contract for lighting the streets for the next ten years comes before the council this week.

The California & Oregon Power Company has recently purchased the Rogue River Electric Company, the Siskiyou Electric Power & Light Company, and twenty-three other companies operating in the neighborhood of Medford. The purchase price is said to be $10,000,000. Officers of the new company are J. M. Churchill, president, Yreka, Cal.; Alex. J. Rosborough, secretary, Oakland, Cal.; A. C. Hough, general counsel, Grants Pass, Ore. Main offices are to be in San Francisco. The aggregate horsepower is to be 250,000, of which the new power station on the Klamath River, about 20 miles from Fall Creek, is to furnish 150,000 and the one already at Prospect, about 50 miles from Medford, can furnish 50,000. Other stations are to be at Gold Ray, Fall Creek, Little Shasta, and Yreka.

LOS ANGELES, CAL.—The City Council has signed and ratified a contract selling $9,390,000 of the aqueduct, power, and harbor bonds to Speyer & Co., of New York. The conditions of the sale are at par with accrued interest at 4½ per cent and the city agrees to create no additional debt until after January 1, 1913. This stipulation does not interfere with any proposition of the city at present. The syndicate takes $2,890,000 of aqueduct bonds, but not $1,326,000 of the aqueduct now in the sinking fund, $3,000,000 of harbor, and $3,500,000 of the power bonds, making a total of $9,390,000. The sale is not optional but firm and calls for the acceptance of the issues in installments before the end of the year.

Aqueduct salvage valued at $1,000,000 is almost ready for the market. The principal items are the $800,000 cement mill at Monolith, the power stations at Cottonwood and Division creeks, and the tufa grinding mills at Fairmont and Haiwee. Whether to sell the big mill at Monolith or retain it and run it in competition with private enterprise is perplexing the council at present. Tufa cement is rapidly gaining in favor with the government engineers. The power stations will be sold to the power department of the city only, and will be run with Haiwee, San Francisquito and San Fernando to make the great aggregate of 120,000 horsepower.

SPOKANE, WASH. The annual meeting of the Washington Power Company was held February 5, 1912 and trustees elected as follows: W. A. White, Hinsdill Parsons, Frank Lyman, F. S. Bangs, Theodore F. Hicks, H. T. White, Jonathan Bulkley, O. F. Jellikoffer, B. B. Lawrence, Guy Du Val, and Edwin G. Merrill, all of New York; Philip Cabot of Boston, H. M. Richards, J. P. M. Richards, L. M. Davenport, W. J. C. McCrea, and D. L. Huntington, all of Spokane. The following figures are taken from the report:

Total assets	$20,79[illegible],071
Capital stock	14,076,900
Outstanding bonds	5,731,000
Street paving between tracks and track improvements in four years	1,035,517
Passengers carried in 1911	23,691,820
Car miles run	3,982,362
Power capacity when Long Lake work is complete	139,000 h.p.
Gross receipts	$ 3,264,168.36
Net earnings	989,682.98
Expenses, including taxes	1,652,980.84
T[illegible]	157,330

The Little Falls Station of this company, designed and built by their own engineers, is said to be one of the finest in the country, both in construction and efficiency. A stor-

age battery has been installed to carry theatre and other loads in case of interruptions of service.

The company laid about 147,000 duct feet of underground conduit and drew in 109,100 feet of underground cable during the year.

Work at Long Lake is going on steadily with about 400 to 500 men employed. There is very little sickness at the camp, due to the excellent sanitary conditions. The concrete dam at this place will be 170 feet high and will store a lake of water 23 miles long and averaging seven-eighths of a mile wide. The entire work is to be done by 1913. The 139,000 horsepower is divided up as follows: Spokane power station, 12,000 h.p.; Post Falls, 15,000 h.p.; Little Falls, 27,000 h.p.; Long Lake, 66,000 h.p.; and Spokane (steam station), 19,000 h.p. In addition there is 25,000 undeveloped h.p. in Spokane. The increase in customers was 6 per cent. The mean rate of interest on the investment is about 6 per cent. For 1912 the estimate of expenditures is $1,510,205 for improvements in both electric light and power service and street railroad work.

The Pacific Telephone & Telegraph Company recently gave a dance to promote good fellowship among its Spokane employes.

INCORPORATIONS.

MOLALLA, ORE.—The Molalla Telephone Company has been incorporated with $2500 capital stock.

OLYMPIA, WASH.—The Reecer Creek Telephone Company of Kittitas County has placed on file articles of incorporation. The capital is $300 and the incorporators are S. Kreidel, W. J. Cahoon, and W. Spurling.

SAN BERNARDINO, CAL. The Yucaipa Domestic Water Company has incorporated with a capital stock of $50,000, and will develop the Yucaipa Valley country. The incorporators are G. A. Atwood of San Bernardino; J. H. Dike and J. H. Logie of Redlands. Redlands is the principal place of business.

PENDLETON, ORE.—Articles of incorporation have been filed for the Interior Electric Power Company, which is to be financed by both Milton and Pendleton citizens, and will furnish power for commercial purposes. County Surveyor Geary Kimbrell and his father have returned from Milton, where they have been surveying the proposed power site on the Walla Walla River.

SALT LAKE CITY, UTAH.—An independent power company, aiming to enter the local field in competition with the existing company, has just been organized in Salt Lake and will begin the development of its power site in the American Fork canyon early in the spring. It is capitalized at $250,000, and is known as the Earle Power Company, of which C. W. Earle is president.

SAN FRANCISCO, CAL.—Articles of incorporation of the San Francisco & Northern Railway Company, organized to build and operate an electric railroad from Santa Rosa to San Quentin, have been filed. The incorporation papers provide for a capital stock of $2,500,000, divided into 25,000 shares at $100 each, and specify that $50,000 of this has already been subscribed by the five incorporators, each of whom took a block of 100 shares. The new road is undoubtedly an extension of the Petaluma & Santa Rosa Railroad and will be 42 miles in length. Its incorporators are: Allen J. and John O. Kittle of Ross; Archibald Borland, president of the American Rubber Company of Oakland; Frank A. Brush, a director of the Santa Rosa National Bank and the Petaluma and Santa Rosa Railroad, and William L. P. Jackson, assistant cashier of E. H. Rollins & Sons, a financial institution.

GOLD RUN, CAL.—To develop electrical energy and furnish water for irrigation projects is the plan of the United Water & Power Company, a new corporation headed by James D. Stewart of Gold Run. Reservoir sites and water rights have been secured by the company on the South Yuba, Bear and American Rivers, where it is proposed to eventually build power plants. A complete report of the projects, four in number, has just been made by W. P. Ireland, a civil engineer of Sacramento, who is also vice-president of the company. In order to carry out the plans for the development of the projects, the company has authorized a bond issue amounting to $5,000,000 and a New York firm has agreed to undertake the disposal of the entire issue. The report of the engineer shows that project No. 1 provides for the development of 5200 miner's inches of water and the generation of 11,900 electrical h.p., with the construction of a power house about 2½ miles west of Blue Canyon. Project No. 2 provides for the development of 5100 electrical h.p. and a power house two miles northeast of Dutch Flat. Project No. 3 provides for the development of 13,000 electrical h.p. and a power house 1½ miles east of Colfax. Project No. 4 provides for the development of 4200 electrical h.p. and a power house 1½ miles southwest of Auburn.

ILLUMINATION.

WATSONVILLE, CAL.—The Coast Counties Light & Power Company will begin shortly to extend its lines to Corralitos.

CARLTON, ORE.—Carlton city officials have been instructed to issue bonds not to exceed $40,000 for water and light purposes.

SPRINGS, CAL.—Work has been started by the San Diego Consolidated Gas & Electric Company on extending their gas mains to La Mesa.

EUREKA, CAL.—A municipal light, power and water plant, costing $1,000,000, was recommended by the mayor in his annual message to the City Council.

SANTA ROSA, CAL.—The application of the Great Western Power Company for a franchise to construct electric poles and lines in this city, was granted, and the franchise passed to print. The company will submit a bid for the city lighting and power on February 20.

KALESPELL, MONT.—The engineers who have been at work at Kootenai falls for the past month have completed their examinations of the power-site there and have returned to New York to prepare their report on the plan to use these falls for obtaining power for the Coeur d'Alene mines and various cities, including Spokane. The Kootenai Construction Company is the corporation organized by Joseph A. Coram of Boston to develop the power.

SAN RAFAEL, CAL.—The Western Power Company has applied to the Marin Supervisors for a blanket franchise to erect poles along the high ways of the county in competition with the present lighting company. In the last few days similar franchises have been applied for in Napa, Solano and San Mateo counties. The Supervisors oppose giving a franchise of that kind, being of the opinion that the routes should be outlined.

FRESNO, CAL.—At a recent executive meeting of the Board of City Trustees an agreement was reached to pass an ordinance lowering the price of gas to $1 a thousand. The present rate is $1.50 per 1000 cubic feet. The ordinance will be passed in all probability at the next meeting, with the understanding that it is not to go into effect until the fall. This is being done to allow the gas company to make the improvements it considers necessary before the new rate goes into effect.

SAN FRANCISCO, CAL.—An announcement is made that Mortimer Fleishhacker has been selected as president of the

Great Western Power Company, in succession to Edwin Hawley, the railroad magnate of New York, who died last week. This carries with it the presidencies of the two subsidiary corporations, the California Generating Company of Oakland and the City Electric Light & Power Company of San Francisco. A. W. Bullard of Boston comes here as the active vice-president under Fleishhacker.

TRANSMISSION.

TACOMA, WASH.—The plant of the St. Paul & Tacoma Lumber Company will be electrified, according to Everett G. Griggs, president of the company.

HEMET, CAL.—Sealed bids will be received up to March 27th for the purchase of a franchise granting the right to construct and maintain for a period of fifty years an electric pole, tower and wire system consisting of all the necessary apparatus for transmitting electricity along the public streets, alleys and roads of the town.

LOS ANGELES, CAL.—The Southern California Edison Company reports an income of $1,728,603, of which $728,376 was from power, the remainder being from light. It sold 16,308,950 kw. hours of light current, and 50,855,954 of power current. It reports a gross income of $379,000. It gives its plant valuation at $9,122,180 for tangible property, and adds $2,280,620 as going or unit value as a concern with assembled property and connected business. In this valuation the distributing system is valued at $2,705,503, and the hydraulic system at $1,980,112. In addition to its city sales the company reports sales outside the city aggregating 82,601,386 kw. hours. For its San Pedro gas system it reports a valuation of $82,721, a manufacture of 13,817,500 cubic feet of gas and an income of $18,331, with expenditures of $15,861.

TRANSPORTATION.

SACRAMENTO, CAL. The application of the Oakland, Antioch & Eastern Railway Company for a franchise to cross the M street bridge, will soon be presented to the Board of Supervisors.

SAN FRANCISCO, CAL.—H. W. Clapp, who has had charge of the electrical construction of the transbay lines of the Southern Pacific, has been appointed assistant electrical engineer of the company under A. H. Babcock.

HAYWARDS, CAL. Work will soon commence on another electric line for Castro valley. An appropriation has been made by the Pacific Gas & Electric Company to run a line on the western side of the valley along the Lake Chabot road.

COLUSA, CAL.—The West Side Electric Railroad have applied for a franchise in Colusa County, granting permission to construct a road across the streets in Hershey, Arbuckle, Harrington, College City, Berlin, Williams, Colusa Junction, Maxwell, Delevan and Princeton.

SALT LAKE CITY, UTAH. Work on an interurban electric railway that will give Salt Lake City connections with Nephi and intermediate points on the south and with Brigham City and eventually with Logan on the north and east, will be started as soon as a franchise can be obtained.

SAN FRANCISCO, CAL.—The Board of Public Works has formally turned over to the Bureau of Engineering the control and direction of the Geary street railway construction, and directed Engineer W. N. Larned, who has been in charge since the removal of former Superintendent of Construction Patrick Broderick, to turn over all plans, papers, tools and paraphernalia appertaining to the work, to City Engineer Mansen, together with a proper inventory of all this property.

RICHMOND, CAL.—The East Shore & Suburban Railway Company, preliminary to double-tracking and enlarging Richmond service, is preparing to increase its power equipment and enlarge its car barn here. It has on the way from the East a new 1500 kw. generator that will cost $40,000. The United Properties Company have part of its system double-tracked to Twenty-third street and Macdonald avenue in time for the picnic season, so as to accommodate the traffic to East Shore and Grand Canyon parks.

FRESNO, CAL.—Paul Shoup, general manager of the electric roads of the Southern Pacific has announced that the Fresno Traction Company is ready to begin construction of its line to the cemetery and confirmed the report that the road would probably go out Olive avenue. Money for the construction of the road has been authorized and the company is ready to start work as soon as the rights of way have been secured. The line will be double-tracked, with the poles in the center and arms extended for the trolley wires. The extension, from Fortcamp and Olive avenues, will be about a mile and a quarter in length. Work will start before the first of March, if rights of way are secured by that time.

TELEPHONE AND TELEGRAPH.

SAN JOSE, CAL. The petition of E. D. Franks and others for a franchise for a farmers' telephone line from Santa Cruz County to the town limits of Los Gatos was granted.

LOS ANGELES, CAL. After operating a wireless telegraph system between Los Angeles and Kansas City, the officials of the Federal Telegraph Company are now preparing to extend operations to Chicago.

SAN LEANDRO, CAL.—After much opposition, the Board of Trustees of this town has decided that all electric light and power wires supported by poles within the town limits must come down and be installed underground within 90 days. To this effect the city clerk was instructed to communicate with the Pacific Telephone & Telegraph Company, Postal Telegraph Company and the Pacific Gas & Electric Company advising them of the action of the board and requesting that the work be completed within 90 days.

PASADENA, CAL. According to the officials of Pasadena and Los Angeles Home Telephone Company, there is apparently no relief in sight for those who have made application for telephones in this city. It is alleged that the unwillingness to install more telephones in the city is caused by the inability to secure a satisfactory franchise, and that the company will not put in the necessary thirty or forty thousand dollars' worth of poles and equipment without being safeguarded by a franchise. It is stated that over 300 applications for phones are being held up. The Inter-city Commission is wrestling with the problem of obtaining a single centralized telephone system for Pasadena, South Pasadena and Alhambra.

SAN FRANCISCO, CAL.—Before the public utilities committee of the Supervisors at their recent meeting, a committee representing the Los Angeles stockholders of the Home Telephone Company, appeared in behalf of the proposal to transfer the property and holdings of the company in San Francisco to the Pacific Telephone & Telegraph Company. James Slosson was the first spokesman for the Los Angeles capitalists, and told the committee that for two years the Home Telephone Company has not received any returns whatever from its eight to nine million dollars' investment. The people of San Francisco did not seem to want two systems, and if a dual system was not desired the Los Angeles stockholders should not be required any longer to put up money to cover losses. He therefore requested that early attention be given the proposed ordinance permitting the Home company to surrender its charter and dispose of its physical properties to the Pacific Telephone & Telegraph Company. Mayor Rolph replied to the Los Angeles representatives that the consummation of the plan of transfer would not have the clear sailing they appeared to anticipate. Chairman Vogelsang told the visiting committee that after all the points raised by the mayor had been given due consideration the utilities committee would make its recommendation.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, FEBRUARY 24, 1912 | NUMBER 8

"The Snow-Capped Sierras"

THE PACIFIC LIGHT AND POWER SYSTEM

BY ROBERT SIBLEY

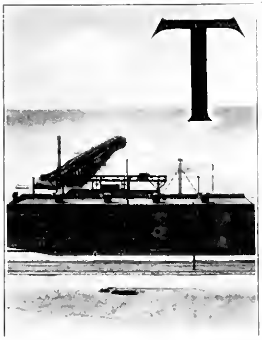
"Scaled the Lofty Summits."

ONLY those who have scaled the lofty summits of the snow-capped Sierras, seen the massive barriers of rock crowned with wind-worn timber, and noted the tantalizing rays of the early morning sun sifting through the rocky pinnacles and casting the deep, clear contrasts in the canyons below, can realize what exquisite beauty really is. Yet it is not for the purpose of picture beauty that this article is written, but rather to set forth the wonderful power's latent in Nature's bountiful waterfalls which suggest a beauty almost beyond a description in words. This beauty is not that of a picture formed for the admiring eye, but rather a beauty realized from a consideration of Nature and her evident endeavors to relieve mankind from his crushing burdens, a beauty which not only delights the eye but touches the heart when we contemplate Nature's bountiful provision for man. Our theme, then is the waterfall

A score of years have not yet passed since Baldwin and Burt constructed the longest distance transmission line in the world, conveying electricity from San Antonio Canyon in Southern California to the city of San Bernardino, distant to the east some twenty miles. What awe and wonder seemed to overcome visitors to this plant in former days. Yet how few years have passed, and now we find electrical energy transmitted distances running into the hundreds of miles, and voltages in the hundreds of thousands. Even now that little power plant, but a few years ago one of the wonders of the world, has been so far outstripped in the advance of the art that, like Goldsmith's "Deserted Village,' it stands silently alone in the canyon where formerly it was "monarch of all it surveyed." Its water wheels lying unshrouded to the cool night air and its concrete foundation-work, robbed of its former ornamental covering, are silent but impressive monuments of the almost inconceivable advance of modern achievements in the engineering art.

It seems but fitting now, in the beginning of the twentieth year since the advent of the original installation in San Antonio Canyon that we should in a measure detail the accomplishments of one of the typical power installations of the West, the reason for this gigantic development and its market.

PACIFIC LIGHT & POWER CORPORATION.



Redondo Pumping Plant.

THOSE gazing down Main street at Los Angeles during certain hours of the day and seeing one solid mile of congested traffic, realize in a small measure where and how such wondrous powers are utilized, and when we know that this has grown into its present large proportions in a short decade, we hesitate to prophesy what the demand for this power may be in the decade ahead.

Again we wander through the manufacturing district of greater Los Angeles and see its rapid upbuilding and the constantly increasing cry for more power, once again we hesitate to answer the question as to where available power will come from to satisfy the demands of the future. But it is not until we pass up and down through the fertile orange groves, across the productive fields of produce and then again look upon the thousands and thousands of acres of arid lands, that we can form a small conception of what the future demand for power will be in the electrically operated irrigation systems for such vast empires of latent possibilities.

Borel Canal Intake.

The properties of the Pacific Light & Power Company comprise seven water power and three steam electric generating stations.

The total hydroelectric output for the year 1911 was 68,744,691 kilowatt hours, 47,826,062 kw. hrs. being generated at Borel, 9,921,400 at Mentone, 12,-277,578 at Azusa, 4,299,440 at Sierra, 353,803 at Highgrove and 728,714 at Pedley. The steam generation was even more remarkable and indicates the need for greater hydroelectric development, the total during the year being 139,462,369 kilowatt hours, 126,377,089 kilowatt hours being generated at Redondo, 11,272,703 at Central Avenue Station, and 1,644,257 at the Third Street Station. The Oil Wells Station produced 168,-320 since this plant was connected to the system, September 20, 1911.

Trunk power lines of the company comprise 433 miles, 127 of which are double circuits of three-phase installations and operate under 60,000 volts, while the remaining 206 miles are also double circuits and three-phase installations but operate at 15,000 volts. In addition to the trunk lines there are 291 miles of distributing lines which make a net-work of the cities of Southern California. Distribution is carried on at 2400 volts.

The company operates 15 miles of single track street railway connecting the cities of Ontario, Claremont and Pomona. These cities are situated in the heart of the citrus belt. They are growing rapidly and their civic pride is of high order.

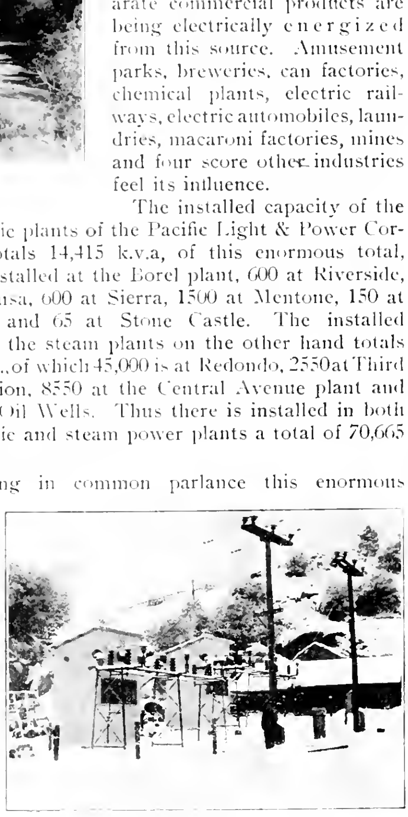
A total of 3505 arc lights are supplied for streets, 3203 of which are in Los Angeles, 275 in San Bernardino and 27 in Huntington Park. A number of towns and cities are supplied with incandescent lamps. In fact a total of 2811 lamps are distributed as follows: 726 50-watt, 6-6 ampere, series lamps serve Hollywood, 544 South Pasadena and 346 Alhambra. At Alhambra there are also 150 forty-watt Mazda lamps, while 50 series carbon lamps are to be found at Covina; 1095 100-watt, 110-volt multiple lamps assist streets of Los Angeles in maintaining their record among the best lighted in America.

About 85 per cent of this power supplies the world-famed electric urban and interurban systems of Los Angeles and of Southern California; 11,000 consumers get their electrical power supply from the gigantic network owned by the Pacific Light & Power Corporation.

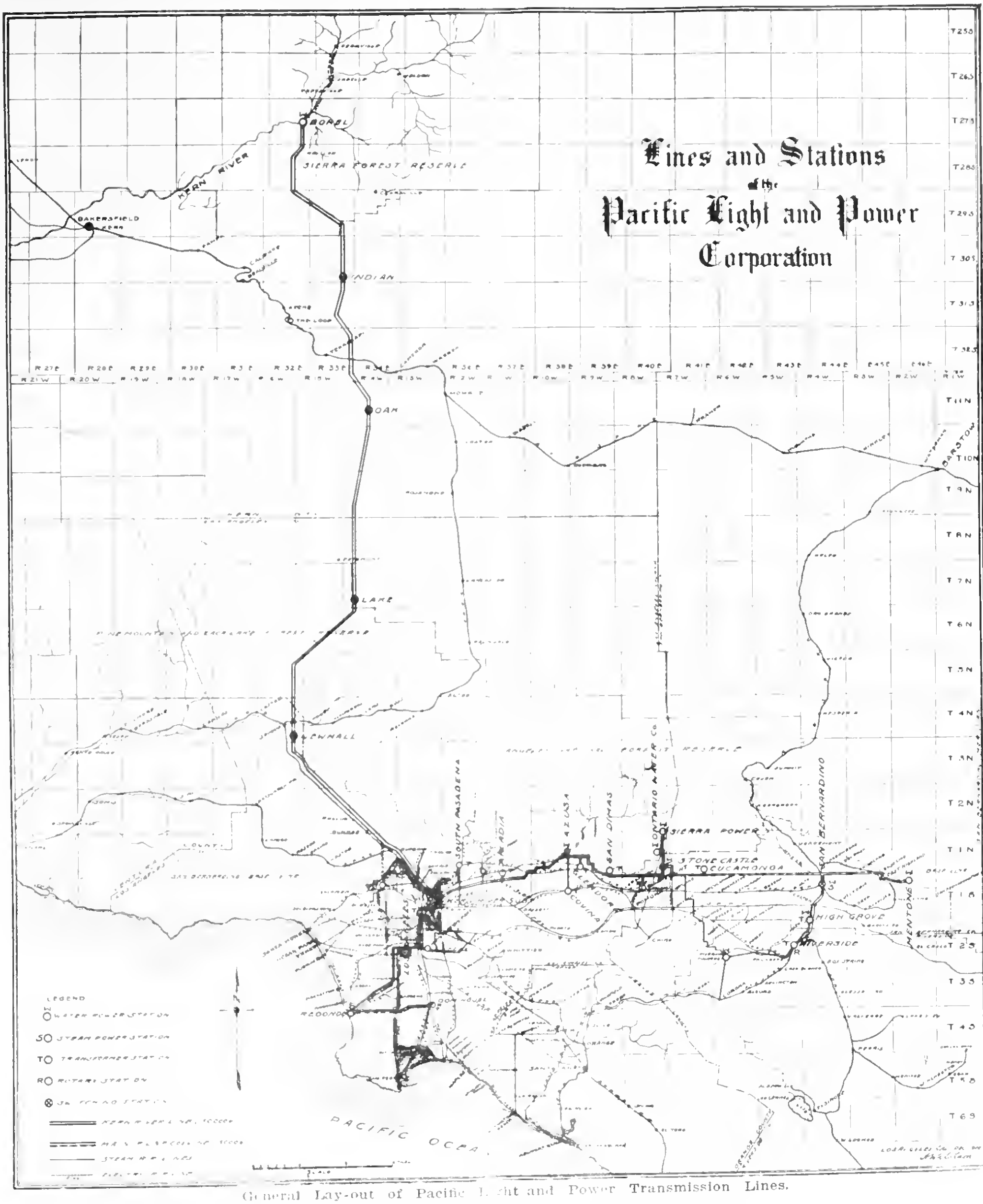
A world of industries are grinding out their supplies for the growing communities in Southern California. These industries are impelled by electrically supplied power from the Pacific Light & Power Corporation. Ninety separate commercial products are being electrically energized from this source. Amusement parks, breweries, can factories, chemical plants, electric railways, electric automobiles, laundries, macaroni factories, mines and four score other industries feel its influence.

The installed capacity of the hydroelectric plants of the Pacific Light & Power Corporation totals 14,415 k.v.a, of this enormous total, 10,000 is installed at the Borel plant, 600 at Riverside, 1500 at Azusa, 600 at Sierra, 1500 at Mentone, 150 at Highgrove and 65 at Stone Castle. The installed capacity of the steam plants on the other hand totals 56,250 k.v.a., of which 45,000 is at Redondo, 2550 at Third Street Station, 8550 at the Central Avenue plant and 150 at the Oil Wells. Thus there is installed in both hydroelectric and steam power plants a total of 70,665 k.v.a.

Speaking in common parlance this enormous generation of energy amounts to 95,000 electrical horsepower. Such totals give but a faint conception of their gigantic proportions. Perhaps



Snow Enroute to Kern River.



General Lay-out of Pacific Light and Power Transmission Lines.

the layman can conceive a clearer idea of this performance when we say that a string of horses, six abreast and thirty miles long, working eternally could scarcely drive the powers supplied from such a source.

Nine cities and towns are supplied with electric energy. These cities have an aggregate population of over 400,000 and comprise the following municipalities: Los Angeles, San Bernardino, South Pasadena, Corona, Covina, Glendale, Alhambra, Azusa and Tropico.

It is interesting to follow the details of this remarkable system and to see its interconnections from the Borel plant six score miles on the north to the distributing network interlinking the prosperous cities of Southern California.

The double pole line of the Pacific Light & Power Corporation with its cleared right-of-way extending from the Borel station scores of miles to the south into Los Angeles presents a neat and trim appearance as it winds its way over the rolling foothills. This double form of installation assures continuous service at all times in the operation of the transmission line.

Again, from the point at which the high tension

lines leave the Redondo station, with their cluster of aluminum electrolytic lightning arrester cells, to the intensified net-work at the Third Street station, the installation work involved in stringing the wires has interesting features.

Here and there may be noted the systematic manner in which the wires stretched in a vertical plane are dead ended, and then quickly the scene changes and they take a horizontal swing for the remaining distance. The Dominguez substation, eleven miles from Redondo, presents an example of this phase of distribution design. Again, when the wires, winding their way overhead suddenly disappear vertically into a 15,000-volt underground cable, the layman is puzzled and perplexed by the manner of its accomplishment.

The Big Creek Plant.

The striking feature of the foregoing compilation of data is that which shows the great preponderance of steam power generation compared to the hydroelectric output of the Pacific Light and Power Corporation. Let us for a moment examine the comparative costs of the two as taken from the books of the corporation for the eleven months ending November 30, 1911. The cost per 1000 kw. at the Redondo steam plant was $3.72 for production and $0.28 for maintenance, making a total of $4.00, while, on the other hand, their hydroelectric generation amounted to only $0.33 for production and $0.58 for maintenance, thus making a total of but $0.91.

It is seen at a glance that the production and maintenance costs of the steam plant on the basis above set forth were over four times as large as the cost of generation by the hydroelectric plant. It is well to note, too, that the Redondo steam plant was only recently completed and may be considered a thoroughly modern and efficient plant in every respect. It burns oil fuel, which, on the Pacific Coast, is much cheaper than coal. Of course the hydroelectric plant, usually being some distance from the market, requires added transmission cost. In the case of the Borel plant this amounted to only 37 cents per 1000 kw. and the average of all transmission expense of the Pacific Light and Power Corporation for the eleven months period was 30 cents per thousand kw.

It is to save this enormous operating expense—in a word, to meet a market within itself—that the corporation is now constructing its present extensive hydroelectric development—a development which will at once place it among the foremost hydroelectric enterprises in the world.

Some sixty miles to the east of Fresno, California, are found the waters of Big Creek, which drain from the high Sierras with their eternally snow-capped pinnacles. The waters of Big Creek and Pitman Creek, a tributary, are being diverted into reservoirs of 102,150 acre feet capacity which require three dams of 160 ft., 90 ft. and 75 ft. height. This water will be utilized first in plant No. 1, which is being installed at the foot of Kerckhoff Dome, with static head of 2,100 ft. and and installed capacity of 60,000 kilowatts. After passing plant No. 1 the water is again being used in plant No. 2, on Big Creek, about four and one-half miles below Kerckhoff Dome. The static head at this plant is 1,900 ft. and the complete installed capacity will be 60,000 kilowatts. Additional water is added to that passing through plant No. 1 by diverting some of the water which rises in Pitman Creek below the diverting canal in the big resorvoir. This compensates for the difference in effective head between plant No. 1 and plant No. 2. Some conception of the storage in these reservoirs may be obtained from the fact that with the ultimate reservoirs full and discharging water at the rate of 300 second feet and with no water flowing into them from any source it would require a period of 170 days to empty the reservoirs.

These two modern twin giants, which are being constructed with sufficient capacity, as noted above, to force into the city of Los Angeles, 275 miles to the south, 120,000 kilowatts of energy, certainly constitute one of the most interesting hydroelectric developments in the world. Let us then go a little more fully into the details of the proposed construction.

Beginning at the waters of Big Creek where the diversion works for plant No. 1 are being located, we find that the specifications call for the most substantial concrete dams known to engineering science. These dams are being built on solid rock bottom and sidewalls. The huge rock dome known as Mt. Kerckhoff is being tunneled and the solid rock walls lined with concrete. The water from the diversion works are to enter immediately into this tunnel and upon coming out to the forebay are to be taken by means of five steel pipes almost precipitously downward some 2100 feet vertical into the power house No. 1 below. The five units here to be installed, which have a capaciity of 11,000 kilovolts amperes each, together with like units at plant No. 2, are to be of the highest efficiency, as to deliver 120,000 kilowatts in Los Angeles.

The water wheels are to be of the tangential type and directly attached to the generating units just referred to. The power house inclosing these giant mechanisms is being built of steel structure, fire-proof throughout, all walls being of concrete filling Each power plant is being equipped with a 50-ton traveling crane in order to handle the most massive of the machinery.

A jump of 1900 feet will be made by the waters in this journey. After the waters have entered the settling basin just referred to they will then be taken through a tunnel 3½ miles long, cement lined throughout. Upon emerging from this tunnel once again they will continue in their precipitous journey to power plant No. 2. As the entire canal work is being built through solid rock tunnels, concrete lined, it is thought that no maintenance charge will ever have to be made for this part of the structure.

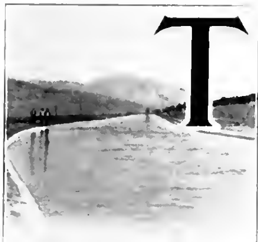
The Big Creek power plant sites are located some 60 miles to the east of Fresno, California. A railroad is now being built 50 miles to the eastward with the proposed terminus immediately at this power plant. This assures simplicity in transportation of the heavy machinery necessary for this gigantic installation.

The 275 miles of transmission line will consist of a double set of steel towers, each tower supporting six wires. At each 40 or 50 mile interval along the line, lightning protective apparatus, together with complete cross-over switches will be installed. Thus will be presented to the engineering world one of the most pliable transmission systems ever built. The current will be transmitted at 110,000 volts and the frequency will be 50 cycles.

(1) Intake of Big Creek Project. (2) The Perpet[illegible] Snows in the High Sierras. (3) Typical Scene in Big Creek Drainage. (4) [illegible]onstructing Roads to Big Creek.

(1) Gathering Engineering Data Near [illegible] Dome [illegible] The Wild Lakes, Head Waters of Big Creek. (3) 11,000 ft. Above the Sea [illegible]rtion [illegible] Proposed Gigantic Reservoir

THE BOREL PLANT.



The Borel Canal.

THE advent of the oil industry in California made many engineers skeptical as to the future of long-distance hydroelectric transmission plants. Yet in spite of the fact that the annual output of California oils now sums the unbelievable total of 75,000,000 barrels, the faith in the hydroelectric installations of California is today more firm and unshakable than ever.

From the station of Caliente, on the main line of the Southern Pacific Railroad, the visitor is met with powerful automobiles and conveyed over steep grades neatly trimmed to perfect evenness. After enjoying some thirty miles of unsurpassed mountain scenery, he arrives at the summit of the crest, from which he is enabled to see, in the beautiful valley below, the Kern River and the canal for the Borel plant of the Pacific Light & Power Company.

Drawing still nearer he is pleasantly surprised at the even surface with which the artificial waterway conveys its burden. Upon arriving at its brink the exquisite workmanship with which it has been finished is noted. The entire surface of the canal is of concrete grouting, 4 inches thick, composed of one part Portland cement, two and one-half parts sand, and five parts of gravel. This grouting is evenly faced with a plaster coating composed of one part Portland cement and two parts of fine sand, which makes a neat workman-like finish. The conduit is so large that two automobiles may pass abreast in its bottom, and the extreme width across the top spans some fifty feet.

Borel Canal Leaving Tunnel

Careful water records are continually being turned off by the automatic registering devices near the intake and lower end of the canal. These devices show the rise and fall of the waters of the river during the different hours of the day. A remarkable feature is that throughout the eleven and one-half miles of conduit, seepage and evaporation cause the loss of only three to four second feet of water. From carefully compiled government data the carrying capacity of a water-way of these proportions, practically diminishes by this amount due to evaporation alone. In fact as one goes from one end of the canal to the other, the exceedingly tight-fitting parts seem to be one of the most striking features.

Painstaking care has brought about this condition. During the low water period of each year the wooden flume work is carefully overhauled by calking the seams between the boards with oakum, and by pouring hot oil upon the oakum after this painstaking work is done. A casual glance at the illustration will show the manner of accomplishing this by boats. Canal walkers are daily kept patrolling the brink of the waterway, and, at a number of points along the line, iron pipes with perforations in their sides have been sunk through the berm of the canal in order to determine whether any stray seepage is taking place. The illustration shows one of the canal walkers collecting his daily data along the brink of this conduit.

The most striking feature of the artificial waterway is the trestle one-third of a mile long spanning the Kern River. The substantial concrete piers show at a glance the permanency of the workmanship, and the perfectly dry supports show the non-leakable compactness of the flume itself. The canal conveys 600 second feet, or in the parlance of the days of '49, it carries 30,000 miners' inches of water.

Upon walking through one of the flumes a full grown man, like the pigmies in Gulliver's Travels, is overcome by his comparative insignificance. The concrete-lined tunnels encountered along the line afford a pleasant variation in the design of workmanship and give added pleasure as one stoops to observe the evenness through and through to daylight on the other side.

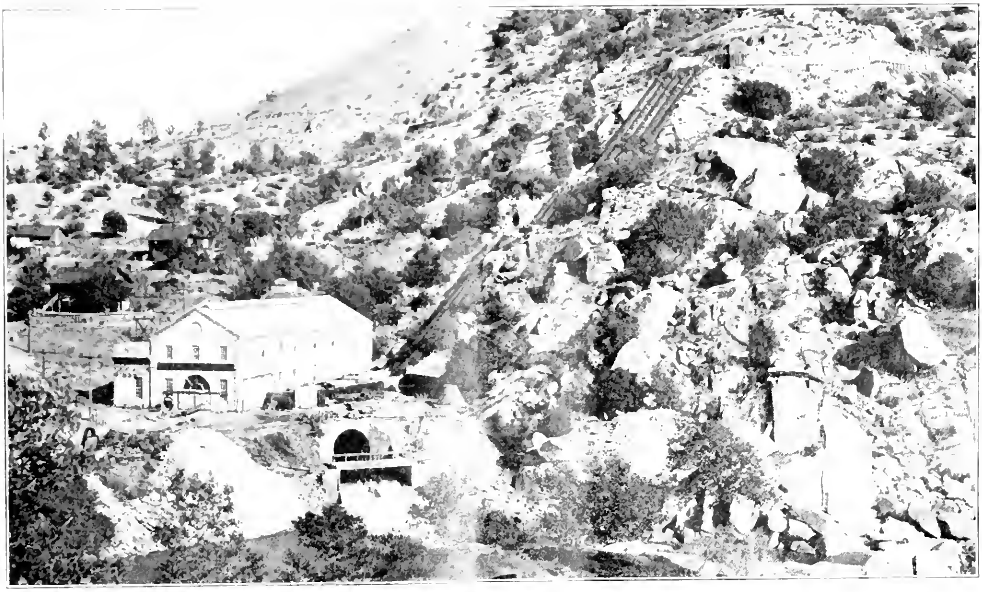
The Company, ever anxious to improve this waterway, has just completed a cut through solid rock some forty feet deep at the highest point, in order to secure permanency in the future by doing away with certain unstable flume work previously encountered.

The intake at Kernville, some two miles above the forking of the river, is interesting. The settling basin at the entrance, 200 feet in width, assures that through the headgate one-half mile below, clear water alone will pass. The carefully constructed spillways along the line, together with the final settling arrangements at the forebay put the finishing touch in securing the cleanest, purest water for the busy wheels below. When one is perched upon the forebay, some 250 feet above the power house, he discovers a pleasing sight as he follows with his eye the five securely-fastened penstock pipes in their drop to the power house below.

The comfortable and picturesque buildings for the attendants may be seen in the distance, and he knows that within the operating house team work of the highest degree is being developed. In descending along the pen-stocks, even the most

Hauling Machinery

The Borel Canal Crossing Kern River



Th[illegible] B[illegible] Installation

casual observer would notice the delicate adjustment of the relief valves which respond to the careful governing at the Redondo power plant a hundred and fifty miles southward.

Before entering the power house the danger sign on the improved lightning arresters in the house adjoining the main power station warns one that 60,000 volts are being used to force the electrical energy 140 miles to the southward.

A small foot bridge spans the Kern River at this point, and two photographs, one taken at high water and the other at low water, give a striking picture of nature's bountiful supply of this powerful fluid in the proper seasons. A weir stretched across the tailrace below the power house indicates that careful data are being continually collected for the operators' use.

(1) Overlooking the Flume. (2) The Relief Valves at Borel. (3) Gathering Seepage Data. (4) The Foot Bridge at High Water. (5) The Foot Bridge at Low Water.

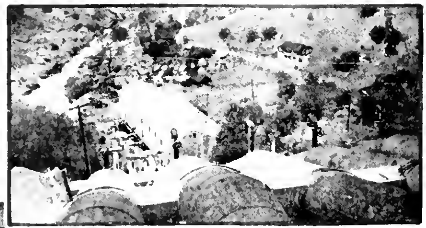
Within the main station powerful Pelton-Francis water wheels, showing by actual test the remarkable efficiency of 85½ per cent, give a faint conception of the conservation of water energy being developed in the plant. The switchboard with its complete modern apparatus shows painted upon it the complete wiring system, thus assuring safe operation even at the most critical and exciting moments.

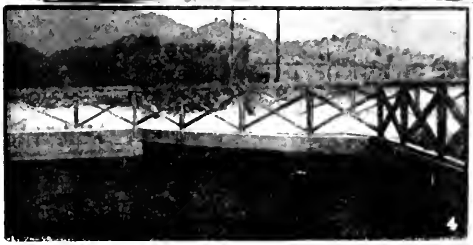
The esprit decorps developed at this station is perhaps the most remarkable of any in the state. The young ambitious attendants, bedecked in their neatly lettered caps and sweaters, show at a glance that the "B" indicates to them not merely "Borel," but everything that is best in industry and attentive care.

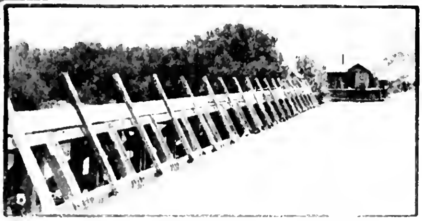
The drainage area from which the Kern river receives its supply comprises the grandest and most ideal met with in hydroelectric installations of the West. Mt. Whitney, towering to a height of 15,000 ft. stands at the head waters of this picturesque river, a silent but impressive sentinel whose duty is that of seeing to it that an abundance of melting snows is supplied to replenish the dry areas below in the height of summer and in winter to store away a bountiful portion for the arid season of the year ahead. A hundred canyons trail their way up toward the summits of the high Sierras and eventually lose themselves in this area of perpetual snows. This hundred-headed monster assures to the Borel Plant an even and continuous supply of water at all seasons of the year.

The present remarkably high efficiency obtained from the Pelton-Francis water wheel installation in the Borel plant above alluded to was not obtained without much study and careful design. The company formerly had five Girard turbines but now after many careful tests, it is found that a great saving in power generation can be made by more modern ideas, consequently the plant is being overhauled and there is being installed four additional units similar to the 2800 kilowatt Pelton-Francis turbine now in operation at Borel.

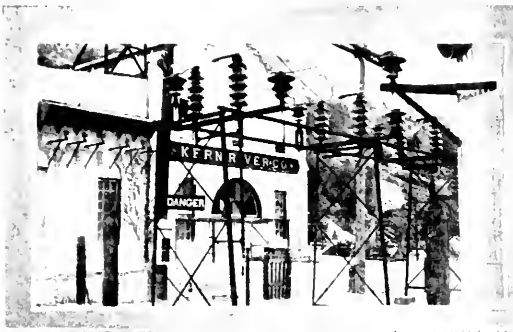
These five water wheel units are being set on concrete foundations laid on bed rock which is uncovered about 15 ft. below the surface. The wheels discharge the waste water into a draft tube which conveys its

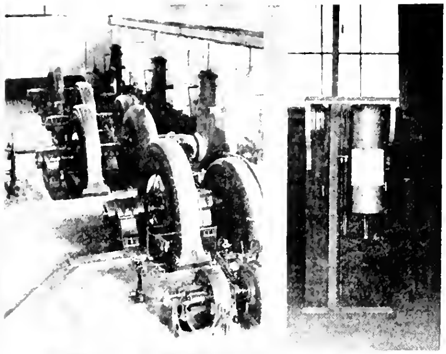


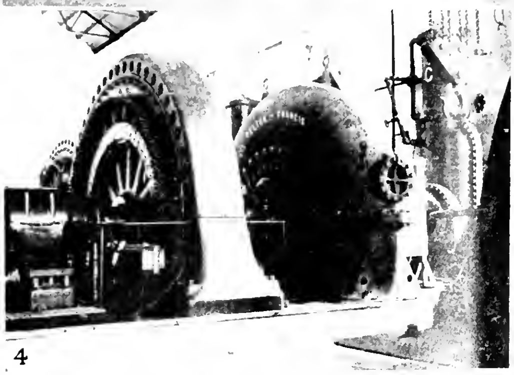




(1) The Borel Plant [illegible] Home [illegible] Being [illegible] View of Power Plant from Forebay (3) The Rocky School House [illegible] Reinforced Concrete [illegible] Borel Canal (5) Head Works on Kern River







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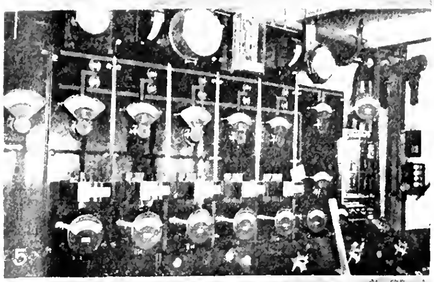


(1) Electrolytic Lightning Protectors. (2) G[illegible] Units [illegible] Borel [illegible] Recording the Water Data [illegible] The Efficient Pelton-Francis [illegible]tallation [illegible] The Switchboard at Borel

burden to the river below. Thus is every available source of energy made use of before the waters finally continue on their journey down the Kern River.

Five generators direct connected with each of the water wheel units are installed in the power house and occupy one side of the building from end to end, as shown in the illustration. Each machine is a 2000 kw. revolving field, three-phase, 50 cycle, 2200 volt, Bullock generator and operates at 230 revolutions per minute. The fields of these generators are excited by direct current from two 150 kw., multipolar, 125 volt Westinghouse generators which revolve at 550 revolutions per minute. These are driven independently of the main generators by two 30-inch Victor water wheels and thus is assured a constant supply of field excitation in case of an emergency. The governors used are of the Lombard type, five for the main and two for the exciter units. Those in the former case are known as type B and in the latter, type F.

The transformer room in which the bus gallery is located is built on the side of the main building away from the river. Here we find fifteen 750 kw. oil insulated, water cooled, step-up, General Electric transformers which operate for 50 cycle, 2200 to 60,000 volt current. The six panel switchboard on one side of the power house in a recessed raised gallery is equipped with one 15,000 volt, and 13-60,000 volt air controlled, oil switches—all of the Kelman design.

As an instance of the many modern conveniences installed at Borel may be cited the ice plant here found which has a capacity of from 1000 to 1500 pounds of ice per day. This is installed in the basement of the power house and consists of one upright ½-ton capacity ammonia compressor manufactured by the Risdon Iron Works. It is driven by a 5 h.p. type C induction motor.

The power house building is a substantial structure and consists of concrete on a concrete foundation with steel trusses and corrugated iron roof. The exterior dimensions of the power house are 64 ft. x 168.5 ft. The altitude above the sea at the power house is 2423 ft., while that of the forebay or reservoir is 2656 ft. Current is generated at 2200 volts and then stepped up to 60,000 at which voltage it is transmitted into Los Angeles.

Canals.

For the first eight miles the water is conveyed by means of a canal 29 ft. across the bottom, 49 ft. at the top and 9 ft. deep, thus making a side slope 1½ to 1. The embankment is 10 ft. deep with the same side slope except in rocky cuts where they are trimmed 1 to 1. The grade or fall in the conduit is 1 in 5000, with the exception of the last five miles which has a grade of 2 in 5000. From this point on the canal is found to be 15 ft. wide at the bottom. When carrying 600 cu. ft. per second, the water is 7½ ft. deep and under these conditions has a velocity of 2½ ft. per second. As has been previously touched upon the canal is lined on the sides and bottom throughout its entire length with a cement concrete grouting.

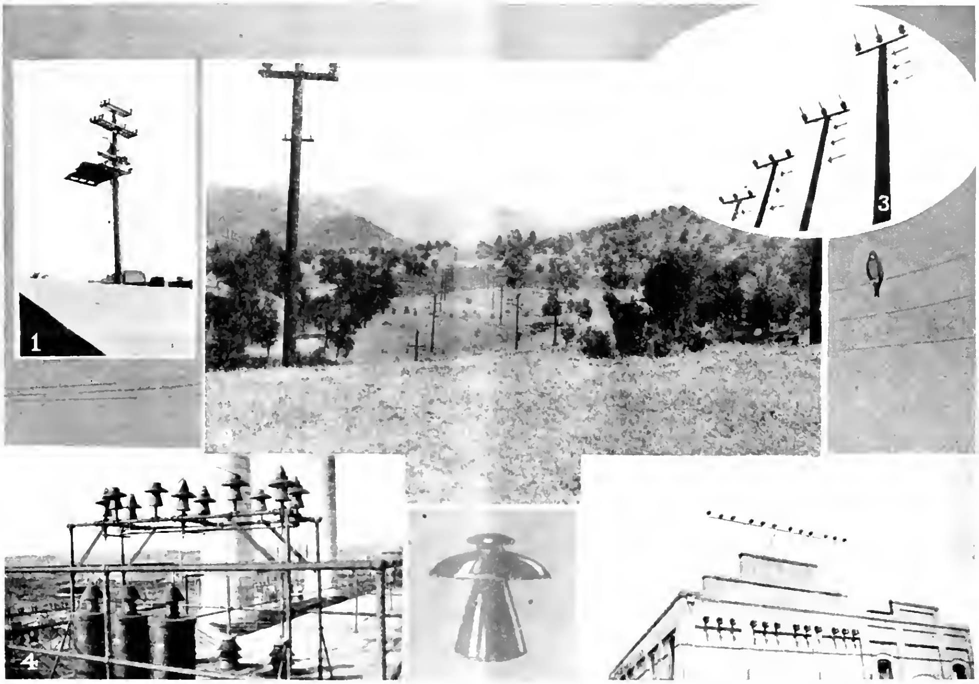
The four tunnels along the conduit aggregate 1982 ft. in length. These tunnels are also lined with cement concrete, have interior dimensions of 10 ft. in width and 10 ft. in depth and are driven on a grade of 1 ft. in every 1000.

The crossing at the Kern River which, as stated above, is by far the most important structure on the line is 1855 ft., the trestle 1371 ft. and the four span bridge 484 ft. in length, carrying a flume 10 ft. wide and 8 ft. deep on a grade of 1 ft. in 1000. The bridge is of the combination type with trusses 18 ft. apart and 29 ft. deep resting on concrete piers which are built on bed rock 15 ft. below the surface of the ground. The top of the flume is 72 ft. above the water in the river. At the upper end of the crossing there is a tapering flume 45 ft. long and, immediately below this, is a waste way for emptying the canal water into the river. All joints in the flume are bevelled to admit calking with oakum upon which hot asphaltum is poured. In the flume sides beaded battens are carefully nailed below the joints in which the hot asphaltum is poured.

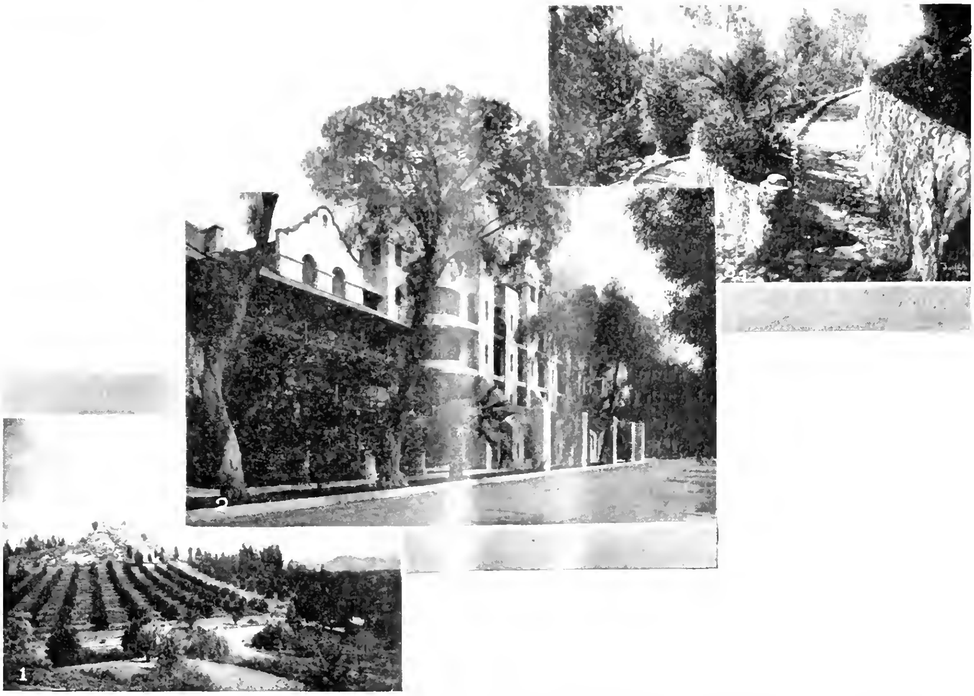
Borel Canal

The forebay, which is built on the steep mountain side as seen in the illustration, is merely an enlargement of the canal. It has been made permanent and substantial by blasting out the solid rock. It is provided with a sand box, screens, weir and sluice gates. The waste way discharges into a ravine thence to the river below the power house. This can be seen in the general illustration of the Borel station. It is interesting to note that the time taken for the water to pass from the head gates to the forebay is 6 hours, 20 minutes, the length of the water way being as stated above, approximately 11½ miles.

The Borel plant was installed the latter part of 1904 and put into operation December 31st of that year. It has been in continuous operation ever since, supplying power to Los Angeles, in addition to the Isabella power station located on the Kern River.



1. Change from Overhead to Underground in Tran[illegible]ssion. [illegible] The Borel High-Tension Transmission Line. 3. Change of Transmission Lines From Vertic[illegible] to Horizontal Plan. [illegible] Electrolytic Light Arresters Redondo. 5. Transmission L[illegible]es Entering Kern River Substation.



1. A Typical Orange Grove—Southern California [illegible]ee Famou[illegible] Glenwood Hotel at Riverside. 3. A Secluded Retreat Am[illegible] the Orange Groves.

REDONDO.


Reciprocating Units.

IN a careful study of the picture shown herewith, which gives in outline the Redondo installation, one is impressed with its lines of beauty and symmetry in design, but when one observes the structure more closely, its massiveness and stability—a fitting tribute to the industry it represents—outweigh all other considerations. The Redondo plant today presents features of design and cleverness of operation that may well be emulated by the central station fraternity at large.

The three huge concrete stacks rising 125 feet in elevation above the boiler room floor line, the three 50-inch steel pipes filled to the utmost with cool sea water which is constantly being returned back into the sea heated to an unbearable temperature, the great oil tanks casting a black silhouette across the sky line, impress upon us with no uncertain emphasis the gigantic forces at work in operating the industries of a busy, growing country.


The Redondo Plant.

Upon the roof whence the net work of wires depart on their journey to the city, the apparent contrast between the nearby fragile but latest improved type of lightning protectors and the massive concrete chimneys in the background is very striking.

No detail seems to have been overlooked for complete and economic operation. Even the little automatic measuring box perched upon the feed-water reservoir, is noted as doing its share to complete the picture. As it swings back and forth it not only measures but purifies the entering feed water.

In descending from the roof we note the long gallery containing the switching apparatus, perfectly complete in its isolation and secure in its fire-proof protection. The operating room below, with its switchboards bedecked with signal lights, impresses us with the idea of ease and simplicity in operation.

Immediately upon entering the space set aside for the huge boilers, we encounter the heated flush of out-going air, which is suggestive of temperatures pictured in Dante's Inferno. But upon closer inspection, we find that the scientifically operated oil burners are efficiently transferring the latent heat energies in the oil fluid to the powerful steam-forming drums above.

Three huge reciprocating steam units, observed in entering the main power room, are seen grinding out with remarkable steam economy a load of 15,000 kilowatts, while on the west, their two smaller but more powerful neighbors are spinning out on their vertical axes 30,000 kilowatts of electrical energy. A massive crane is observed to travel back and forth at the fancy of a small speck in one corner of its frame-work. Upon closer examination the speck is seen to be a human being, at first unrecognizable because he appears so small in comparison with the rest of the structure.

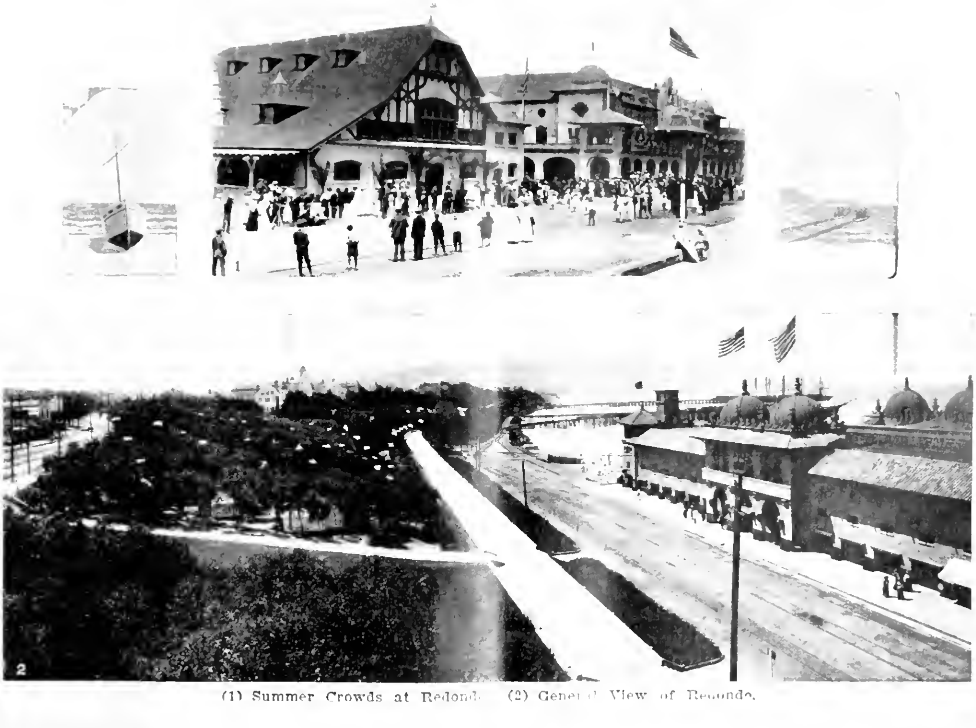
In going below we are reminded by the condensing apparatus, with their thermometers placed at proper points along the line for accurate steam economy records, that the steam which has so recently been used to drive the gigantic machinery above, is now once again forced to betake itself into the same boilers to be again used at the will and pleasure of man.

The reciprocating engines found driving three 5000-kilowatt generators were purchased on a guarantee that 170 kilowatt hours be generated per barrel of oil, each barrel weighing 334 lbs. and each lb. containing 18,500 B.t.u. One B.t.u. is that amount of heat required to raise one pound of water one degree in temperature. After an impartial test covering fifteen days, it was found by the group of experts in charge that as a matter of fact 252.8 kilowatt hours were generated per barrel of oil, thus showing one of the most remarkable tests of economic operation on record.

Many pages could easily be devoted to describing the special features made use of in perfecting the efficient operation of this plant. By peering into the intake of the long pipes used in supplying the condensing water, new and improved ideas are seen at once in handling seaweed. By still further following up the circulating water passing through these pipes, new ideas in valve operation and discharge are quickly discerned. The switchboard panels and the wiring leading to it, all possess features of improved and economic installation.


Measuring and Purifying Tank.

(1) Pumping Connections. (2) Intake of Circulating Water. (3) Mammoth Oil Tanks (4) Grizzles for Sea-Weed Protection (5) Electrolytic Lightning Arresters.



(1) Summer Crowds at Redondo (2) General View of Redondo.

The building, housing the apparatus, is solid and substantial. Its concrete walls are a fitting tribute to the substantial industry it represents.

To go more into detail in describing the complete equipment of this plant, we find that there are, in the main generating room, three McIntosh and Seymour engines which drive three 5000 kilo-volt-ampere General Electric generators. There are also, as has been mentioned above, two Curtis General Electric turbo-generators, each of a capacity of 15,000 kilo-volt-amperes. The three 5000 kilo-volt-ampere generators have 60 poles each and furnish three-phase alternating current at 18,000 volts, 50 cycles. These are driven at 100 revolutions per minute by the three vertical, compound, side-crank McIntosh and Seymour automatic, gridiron valve engines above described.

The two turbo-generators alluded to are driven at 750 revolutions per minute and are of the vertical type with condenser base and generate current at 50 cycles and 9000 volts. Since the reciprocating units deliver current at 18,000 volts—the voltage of transmission to Los Angeles—the turbo-generator voltage is raised from 9000 to 18,000 by means of six single phase, General Electric compensators which are Y-connected, oil and water cooled. A separate compensator is also provided. Excitation current is derived from a 100 kw., 4 pole General Electric horizontal turbine exciter, the normal excitation being 60 kw. at 250 volts. The speed of 2400 revolutions per minute is that at which this unit is driven. The unit is operated non-condensing. The step bearings, necessitating an oil pressure of 1000 lbs. per sq. in., are supplied by three steam driven horizontal duplex pumps which are designed to amply take care of the enormous pressures here met.

Superheated steam, which is found of most economic use in the modern turbine, is supplied by 601.9 h.p. Stirling water tube boilers. These are of type 0-24 and are arranged in four batteries of two each. Fuel oil is the source of heat supply.

The make-up water for the plant is supplied by wells on the property and is purified and preheated by two 10,000 h.p. Cochrane vertical feed water heaters and purifiers, right and left connected.

Three reinforced concrete chimneys, which are shown in the illustration, are of massive design. Their height above the boiler room floor is 125 ft., the depth below the boiler room floor being six ft. The inside diameter of the top is 13 ft. and the thickness of the wall at the top and bottom is 7 inches and 10 inches respectively. The foundation concrete is composed of one part Portland cement, three of sand and five parts stone. All the chimneys are provided with two 30-inch clean-out doors.

The most novel and interesting feature of this plant is the system of condensation whereby vacuum is obtained upon which the efficient operation of the turbine is so dependent. The condensers are of the surface type, the steam being condensed by coming in contact with metal tubes through which cold water is constantly circulating. The main condenser for each turbine is in its base. There is also an auxiliary condenser with all necessary water and steam connections. Seventeen miles constitute the journey of the circulating water through the condensers.

Fuel oil is stored in large supply tanks which have a storage capacity of 40 to 45 days. The oil is pumped into auxiliary tanks outside the building at one end of the boiler room, each tank having a capacity of 1000 barrels.

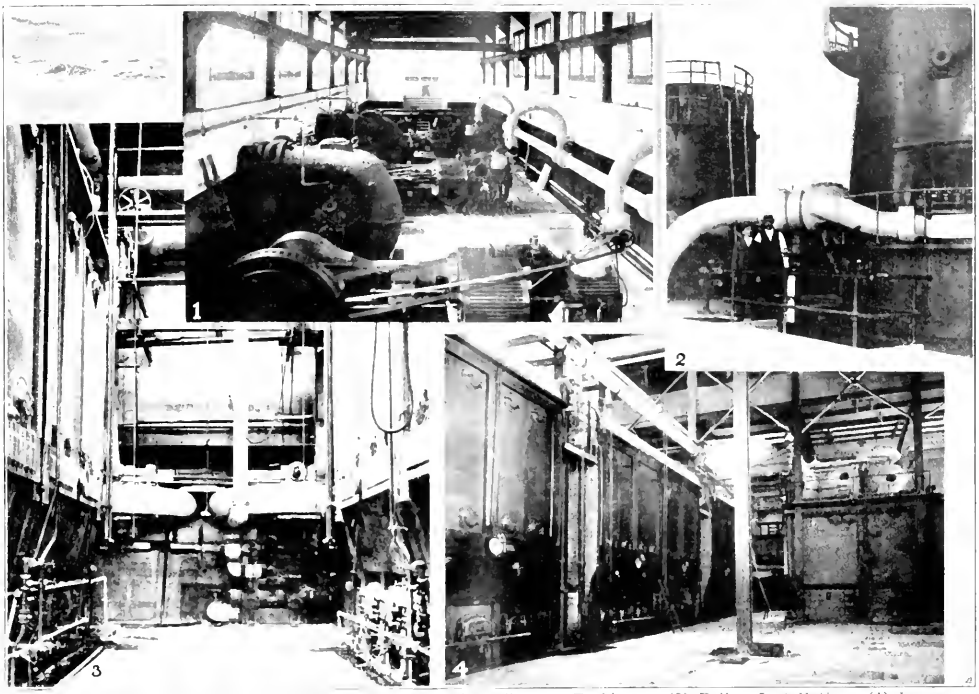
Auxiliary Power Plants.

In addition to the giant installation at Redondo, the Pacific Light & Power Corporation has in operation three other steam plants. The largest of these is that known as the Central Avenue Station and is leased by the corporation from the Pacific Electric Railway. This station was put into service about the year 1902 and has a capacity of 8550 kilowatts. The prime movers are reciprocating units of the Alberger and also the McIntosh & Seymour cross compound engine type. The Central Avenue Station derives its output of 8550 kw. from two 1500 kw. Stanley induction type and three 1500 kw. Bullock generators. One 550 volt, 1050 kw. direct current Westinghouse generator supplies all needs for direct current. The building is of brick and is 140 x 200 ft. There are here installed also, three 500 kw. Stanley transformers for each of the 1500 kw. generators above alluded to.

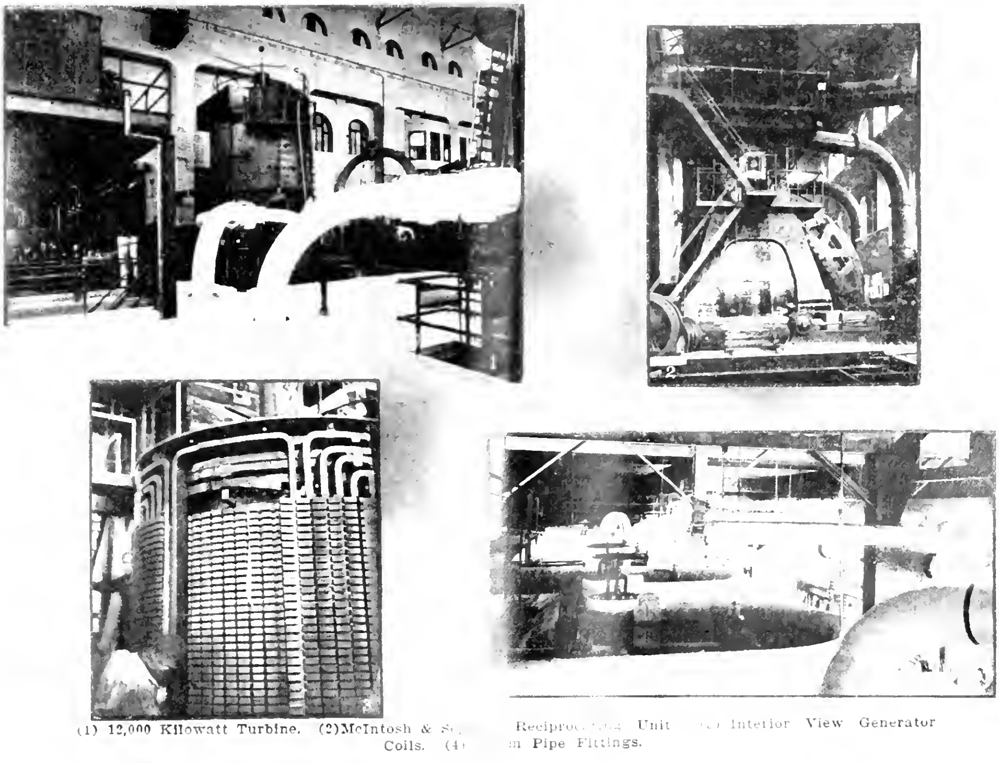
While not so large in installed capacity as the Central Avenue, the Third Street Station far exceeds it in importance. This station has an installed capacity of 2550 kilowatts. As a generating unit it fades into insignificance in comparison with its importance as the life-giving, main artery for the complete installation of the Pacific Light & Power Corporation. Here we find the executive heads directing the operation of both the steam and hydroelectric units. From the Third Street Station emanates the orders which bind the complete hydroelectric and steam development into one pulsating electrical force. In 1898 the Third Street Station was put into efficient operation. The 2550 kw. capacity of this plant consists of one 1500 kw., one 750 kw. and one 300 kw. generator delivering current at 2400 volts, 50 cycles per second. There are no transformers utilized as the buses are fed directly with the 2400 volt current. The building is a substantial brick structure 85 x 125 ft.

The 150 kw. generator is of the General Electric design and delivers current at 2200 volts, 50 cycles per second. The building is of corrugated iron as shown in the illustration and is 50 x 60 ft. A compound Ball engine direct connected with the generating apparatus is the prime mover. Also installed here are two 125 kw. Westinghouse transformers which are connected in open delta.

The output of the California oils for the past season exceeded the enormous total of 78,000,000 barrels and yet in spite of this, electrically operated oil pumps are each day coming into favor and meeting with the popularity of the oil-field management. An opening for electrically operated oil wells has just been made in the Los Angeles installation although at Bakersfield, 150 miles to the north, the old system of oil drilling is rapidly disappearing. Convinced of this growing field of power consumption, the management of the Pacific Light & Power Corporation made a beginning during October of the past year in the meeting of this new need. An installation of 150 kilowatt capacity was made during this month in the midst of the oil wells at Los Angeles.

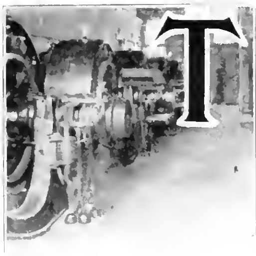


(1) Pumps for Circulating Water (2) Two 12,000 Kilowatt Turbines (3) Boiler Installation (4) Interior View of Boiler Room



(1) 12,000 Kilowatt Turbine. (2) McIntosh & S[illegible] Reciproc[illegible] Unit [illegible] Interior View Generator Coils. (4) [illegible]m Pipe Fittings.

Azusa.



Operating Room—Azusa

THE Azusa plant commands a surprising view of the surrounding country. Immediately to the south are thousands of acres of fertile lands nourished by the encouragement from power enterprises of this sort. One mile to the south are the electric railway lines which hurry into the great city of Los Angeles within an hour's time.

The waters used to develop electrical energy in this installation are taken from San Gabriel Canyon and are conveyed through a canal some six miles in length. The intake consists of a reinforced concrete diversion dam of sufficient height to force all the waters of the creek into the canal up to its full capacity. Iron grizzlies protect the canal from incoming driftwood and other rubbish.

The water finally passes through a tunnel 1/3 mile long and emerges at the forebay whence it passes to the power house 404 feet below, through a 38-inch steel pipe. Where the water enters the forebay, two spillways are constructed to handle the excess water or in case of a shut-down to carry away the full head.

Bird's-eye View of Azusa Plant.

The power house is constructed of reinforced concrete with corrugated iron roofing and contains five 300 kw. 50 cycle, two-phase, 500 volt Westinghouse generators, running at 430 revolutions per minute. These are direct connected to four double Doble water wheel units, and one unit of the Pelton pattern. The wheels have two disks per unit. Two of the units are governed by the Lombard type F governor while the others are hand controlled. Belt driven from the generators are four 7½ kw., direct current, multipolar, 125 volt Westinghouse generators which are used as exciters.

The transformer room, above which is the bus gallery, is situated on the up-hill side of the building and extends its entire length. Here are installed eight 200 kw., oil insulated, water cooled, 50 cycle step-up Westinghouse transformers. By means of the Scott connection the voltage is raised from 500 two-phase, to 17,500 volts three-phase.

Ever eager in their efforts to improve obsolete or inefficient apparatus, the company is installing aluminum electrolytic cells for lightning arresters, thereby replacing the present spark gap installation. This improvement is also being undertaken in all of the other plants owned by the company and not as yet equipped with this improved design.

Not satisfied with utilization of the six miles of San Gabriel Canyon waters as just described, the company is at present installing a second plant 17 miles up this canyon. The installation will comprise 10½ miles of conduit which includes two 4-mile tunnels. The tunnels are to be 7 x 3 feet concreted throughout. The waters of San Gabriel Canyon, after being conducted through this 10½ miles of canal, will arrive at the forebay from which they will be taken almost precipitously 1000 ft. downward into the power house below, where a plant of 6000 kilowatt capacity will utilize their enormous kinetic energies.

When we see a completed hydroelectric plant before us resplendent in the beauty of the noon-day sun we are not always able to properly picture the engineering skill and planning it has necessitated. No small item among these features is that of transporting over a rough and precipitous country, the heavy machinery required in the installation. This new undertaking in San Gabriel Canyon is no exception to the rule and now, during its days of construction the picturesque sight of the pack train and the freighter can be seen wending their way up the narrow defile. Transportation, like the other apparently unsurmontable obstacles met with in engineering practice, are, however, but mere child's play in the hands of the constructive engineer. They serve, nevertheless, as monuments of accomplishment in hydroelectric development in the West.

Like the waters of Santa Ana River, those of the San Gabriel will perform the task of grinding out energy for the burdens of man over and over again, as they descend toward the valley below. This is a striking feature of the hydroelectric development in Southern California where water plays the important role. Although they are eventually to be used in irrigation, first they are harnessed to give up their latent energies for man's use.

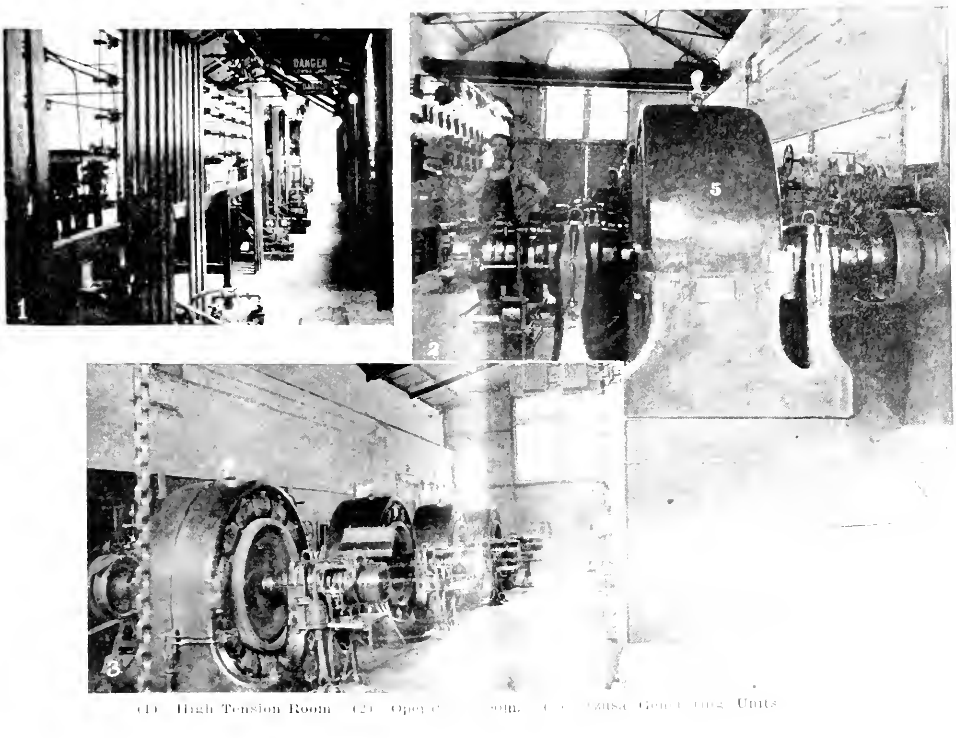
It is interesting to examine a summary of the main features in this plant. This is found in the following:

Physical Data for Azusa.

Length of main ditch and flume system, 6 miles.
Flow per second in main ditch system, 80 sec. ft.
Elevation of head (total drop), 401 ft.
Number of impulse wheels, 4 Doble and 1 Pelton.
Total electrical h.p., 1500 kw., 5-300.
Generator voltage, 500 volts.
Altitude of forebay or reservoir, 1250 ft.
Altitude of power house, 850 ft.
Exterior dimensions of power house, 47 ft. x 72 ft.
Material of building, concrete on concrete foundations, with steel truss and corrugated roof.
Date of placing plant in service, June 30, 1898.

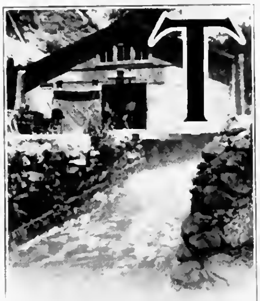
Spillway, San Gabriel Canal.

(1) Forebay (2) General View plant (3) Penstock (4) Intake Azusa Canal



(1) High Tension Room (2) Operating Room. (3) Azusa Generating Units

SIERRA AND STONE CASTLE PLANTS.



Tailrace, Sierra.

THE beginning of the installation known as the Sierra Plant was a history maker for hydroelectric development. In 1892 awe-inspired visitors were informed that the little concrete building housed the longest distance transmission power plant in the world. The delapidated structure shown in the illustration is the silent reminder of this historical event.

Mt. San Antonio, locally known as "Old Baldy," forms the major portion of the watershed for nearly all the streams supplying the so-called citrus belt in Southern California. San Antonio Canyon, through which flows the creek of the same name, is situated to the north, and midway between Ontario and Pomona, two of the most enterprising orange producing sections of the State. The canyon is picturesque; about six miles from its mouth a stone barrier several hundred feet in height, commonly known as the "Hog's Back," completely checks the waters of San Antonio Creek in their mad rush to the fertile valley below. As if, however, crazed with frenzy at being thus thwarted in its peaceful journey, the stream, as shown in the illustration, leaps over a series of waterfalls through a depression in this Hog's Back.

Stone Castle Plant.

Engineers, early in the '90s, conceived the idea of diverting the water of this creek immediately above the waterfalls and taking it by means of a tunnel through the Hog's Back, thence by pipe line down to the old Sierra plant. Ideas were crude in those pioneer days, and the old switchboard, shown in the illustration, bears record of the fact that the first high tension transmission plant in the world conveyed energy at 10,500 volts, generated this electric power at 1,000 volts, which was stepped down to 500 volts, and then by means of twenty-one of the secondaries of these transformers connected in series, 10,500 volts were obtained for transmission.

But this is of historical interest. Let us pass now to the present status of this complete power installation. The waters are diverted as formerly, but instead of the crude flume diversion works, there is now built a substantial concrete and rubble masonry diversion dam from which the steel riveted pen-stock pipe takes its water, passes through the tunnel above referred to and then, as shown in the illustration, down through the original pipe line to the new power plant

The Sierra plant consists of two 54-inch 400 h.p. single Pelton water wheel units which are governed by a type F Lombard governor. The riveted steel pipe line running directly to the power house from the intake above the Hog's Back, has three varying diameters, namely 30, 26 and 22 inches. The pipe line is substantially installed and is in excellent shape at the present time. The water wheels which are located immediately without the building are installed on concrete foundations and deliver water through the cement lined tail-race as shown in illustration.

Directly connected to these two water wheel units are two 300 kw. Westinghouse generators operating at 430 revolutions per minute. The exciters, two in number, are belt driven and are of the Westinghouse, 5-polar, $7\frac{1}{2}$ kw. direct current, 125 volt type.

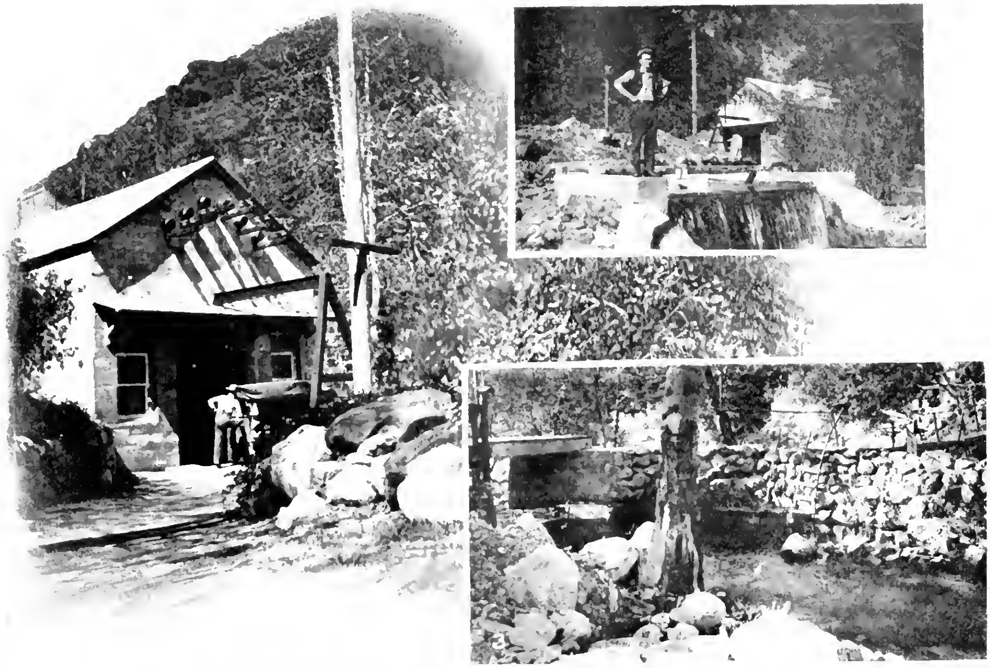
The transformers in the main operating room are in two banks, one containing two 200 kw., oil insulated, water cooled, 50 cycle, 500 volt two-phase step-up Westinghouse transformers raising the voltage to 17,500, three-phase Scott connection. The other bank is of similar detail but consists of two 250 kw. transformers instead of the 200 kw. capacity.

The Stone Castle plant utilizes about 200 miners' inches of water hitherto passing by subterranean channels to the sea This water is conducted around the east side of the entrance to San Antonio Canyon, and finally by means of a steel pipe, it is passed through nozzles, develops 65 kilowatts and is then used to quench the thirst of former desert lands now supplied by the Ontario Water Company, who developed this supply by diverting it from subterranean sources.

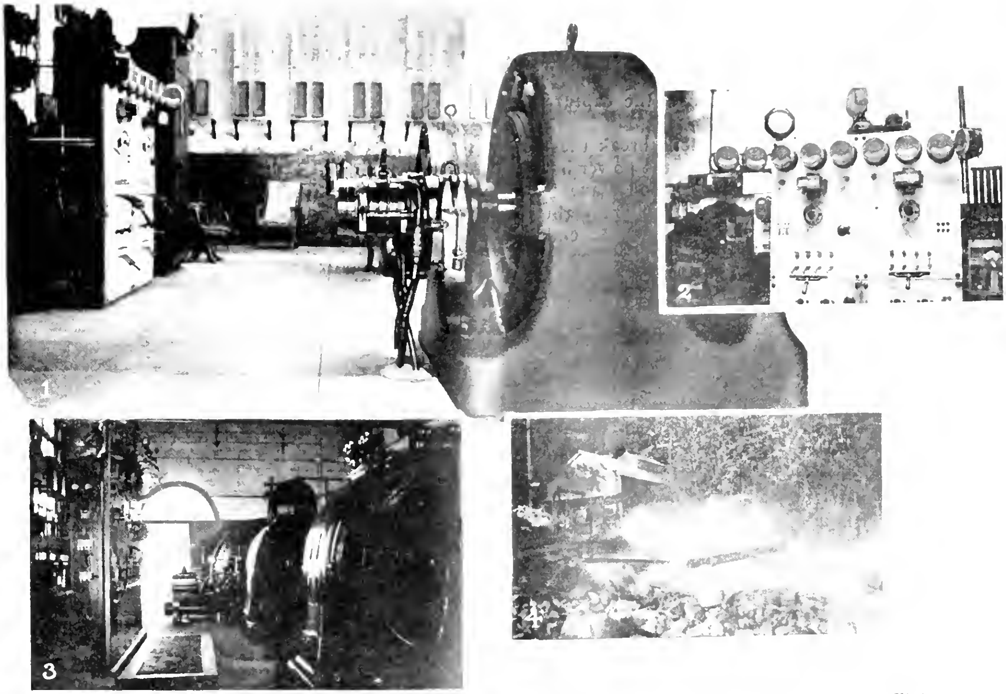
This station is not connected in parallel with the main generating net-work. At the power house, nevertheless, may be found switching apparatus from which the main circuit distribution can be regulated.

The power developed in this installation is used mainly to operate some twelve to fourteen miles of electric railroad owned by the Pacific Light & Power Corporation. This plant is situated at the head of several miles of incline. Formerly this seven and one-half miles of steady rise were operated by means of mules, which pulled the car to the head of Euclid avenue. There the mules were placed on an attachment in the rear of the car, and the car, with its livestock attachment, was then rolled down by gravity the entire distance.

Waterfalls at Hog's Back.



(1) Power Plant House (2) Weir Foot ... Tail Race (3) Concrete Intake Sierra Canal



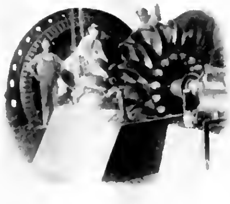
(1) Interior Operating Room (2) Switc[illegible] ...nel ... [illegible] ...perating Unit (4) Spray from Water ...eels

MENTONE.

Woodstave Siphon.

IF the observer follows the waters of the Santa Ana from the time they rise in the snow-capped mountains until they lose themselves in the fertile, irrigated fields below, a most interesting and economic study in power development is at once apparent, for the waters of this river are diverted through concrete lined canals, then through pen-stocks and water wheels, over and over again in their journey to the sea. The waters, however, during many months of the year never reach the Pacific. When they have finally served to their fullest extent the demands of power generation they are completely absorbed in irrigation applications and leave but an "arroyo seco" or "dry river" to mark their pathway to the ocean.

The Mentone power house, three and one-half miles east of Mentone, on the Santa Ana River, is one of the newest of the Pacific Light & Power Company's plants, having been installed in 1904. The intake dam about three miles above the power house, is massive and substantial, being constructed of reinforced concrete and rubble masonry, and, as shown in the illustration, the waters are controlled by substantial gates. When they are once started upon their way to the power house, the capture of the waters is complete.



Water Wheels a' Mentone.

Open flumes, tunnels and siphons break the monotony of flow in their merry rush to the power house. The siphon work, consisting of redwood stave pipe, is 60 inches in diameter. The tunnels are eight in number, one being 1400 feet long. At the end of the conduit the waters are turned into the pen-stock 352 feet above the power house. Let the supply of water through the pen-stock be checked for one instant, and the spillway, as shown in the illustration, forms a beautiful waterfall as picturesque as those of the Yosemite.

The altitude of the Mentone power house is 1898 feet above the sea while that of the forebay or reservoir is 2250 feet. The canal is designed to carry 80 second ft. of water and is of thorough workmanlike finish throughout its entire length.

The power house itself is built of reinforced concrete, 50x40 feet with corrugated iron roofing. A standard twenty-ton crane is erected on the side walls for use in the installation of machinery. There is in operation one 1500 kilowatt revolving field Westinghouse generator. A carefully balanced governor is master of the situation, controlling any tendency towards unsteadiness of load conditions. The plant is also equipped with exciters, transformers, lightning arresters and other necessary accessories.

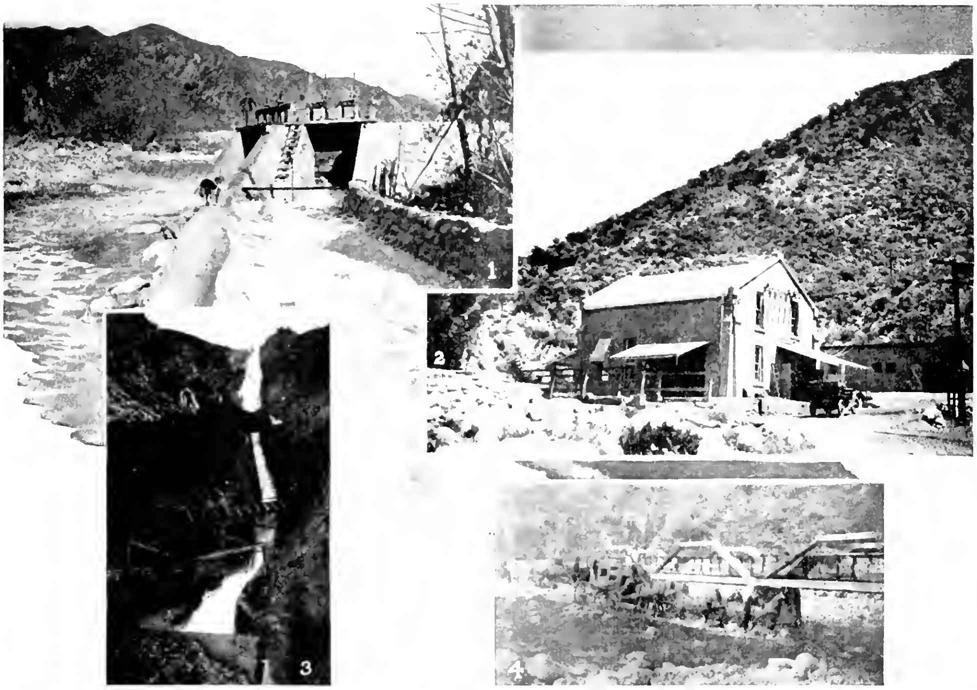
The company is now engaged in replacing the older type of transformers by 3 improved 750 kilowatt General Electric transformers, thus again illustrating the company's zeal in keeping up with the march of progress in affairs electrical.

As we gaze out into the arid but fertile valley stretching forth from Santa Ana Canyon, the possibilities of this district cannot help but deeply impress us. Water is the only crying need and when once applied the arid valley certainly shows its deep appreciation. An interesting water development has taken place almost immediately below the Mentone power plant. During the flood period when thousands of acre feet of water would ordinarily rush madly to the sea, these waters are not only corralled in the big reservoir dams above but even the surplus is flooded over the arid lands at the mouth of the canyon. It has been found that the water so flooded stores itself for a period beneath the surface and a few miles down the valley during the dry season, by means of electrically operated pumps, it is found once again subservient to the use of man. This demonstration during the past season has convinced practical men of the availability of this method of water development. Once again we see that this process of developing water and thus making the arid lands blossom is resulting and will continue to result in the utilization of thousands of kilowatts of electrical energy to operate the necessary pumps.

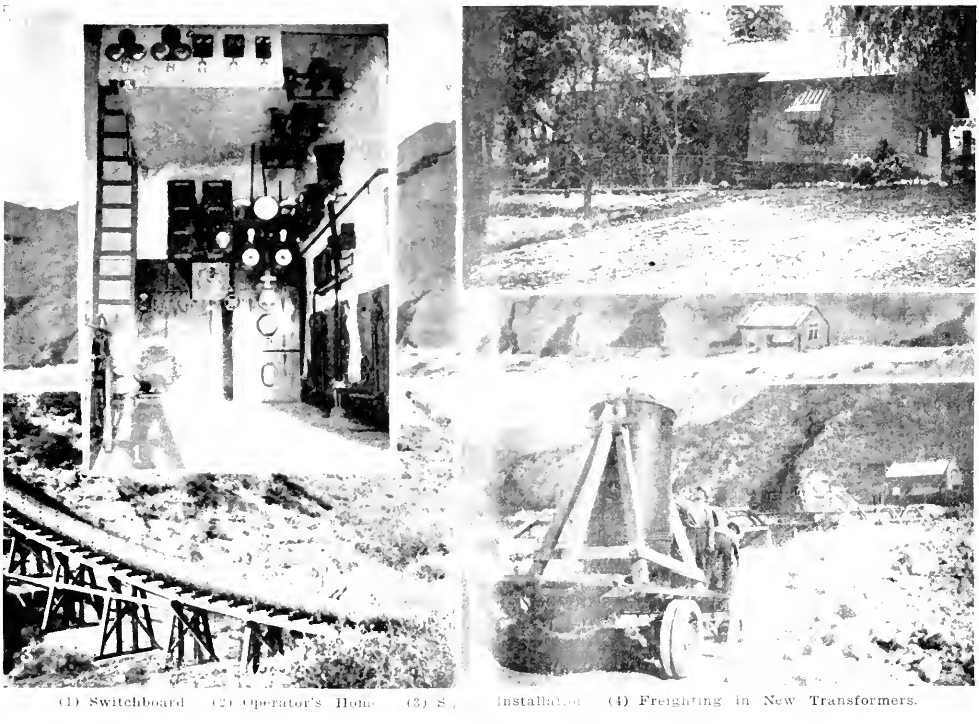
The Mentone power plant is located some seven miles from San Bernardino. Here we find a remarkable situation presented. San Bernardino, though situated in the heart of perhaps the most productive section of the citrus belt, is yet not in itself a heavy producer of fruits. Due to its unusual railway facilities, however, it is rapidly becoming the center of a distributing net-work which augurs well for future growth, both as to a distributing and manufacturing center. The field then for future power consumption in this locality is of unusual promise.

San Bernardino County is the largest county in the State, and in fact in the nation, its area comprising 20,160 square miles. The city of San Bernardino owns the largest artesian well in the country, flowing 3,000,000 gallons every 24 hours. More, longer and heavier trains carrying fresh fruit are made up and sent out of San Bernardino than out of any other shipping port in the world. The cultivable area of this county supports more persons per square mile than any other rural district in the country. Three transcontinental railroads: the Atchison, Topeka & Santa Fe, the Southern Pacific, and the Salt Lake pass through this metropolis, and their shops keep thousands busy.

"Stage" at Mentone.

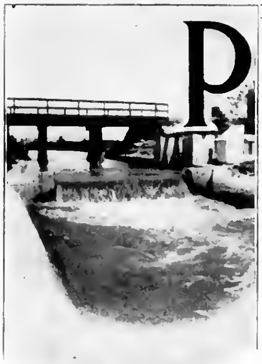


(1) Reinforced Concrete Intake (2) Power House (3) Spill Way. (4) Santa Ana River Near Power House.



(1) Switchboard (2) Operator's Home (3) S[illegible] Installation (4) Freighting in New Transformers.

PEDLEY AND HIGHGROVE.



Canal for Pedley Station.

PEDLEY is situated a few miles out of the city of Riverside, the beautiful city in the county of the same name, this being the youngest of the seven counties that constitute what is properly known as Southern California. Riverside County has over 7,000 square miles of territory and a population of about 25,000, and its assessed valuation speaks to the extent of $18,000,000. Three transcontinental railroads annually groan under the burden of 6,000 car loads—2,304,000 boxes—of high grade citrus fruits produced herein.

Picturesque Riverside County has within its border 130 miles of irrigating canals which cost over $4,325,000. Thousands of acres in addition but await proper facilities in the way of more electrical power to pump water in order to make them blossom as the rose. An annual income of nearly $9,500,000 from this county is a sufficient guarantee that its boasted agricultural possibility is no mere joke.

Operating Room—Pedley.

The handsome concrete bridge structure shown in the illustration is that of the newly constructed Salt Lake Railroad passing over the Santa Ana near the intake of the canal which feeds the Pedley power plant. In fact a careful observation of this picture will discover in outline the canal and headworks just alluded to. The canal is six miles from the intake to the forebay, just above the power house and shown in the illustration. It is a small concrete structure situated on the hillside eighty-seven feet above the power house. Grizzlies protect the entrance to the pen-stock, and the spillway, which can be seen in the photograph, conveys the excess water to the river below the power house.

The main ditch and flume system for the Pedley plant is six miles in length and is designed to carry 100 second ft. of water. The total drop of the water from the forebay to the power house is 86 ft. The altitude of the power house above the sea is 514 ft., consequently that of the forebay is 680 ft.

The exciters used in this plant are General Electric type machines generating 136 amperes at 125 volts. These operate either by separate water wheels or by induction motor so arranged that it can propel either one of the exciters. Stanley transformers, stepping from 10,500 to 17,500 volts enable this plant to operate in parallel with the other installations of the Pacific Light and Power Corporation.

The five panel switchboard provided with all modern instruments together with improved circuit breakers and two 1500 volt 3-pole hand controlled Kelman oil switches complete the main equipment. Improved electrolytic lightning arresters will be installed in the near future. These arresters are being installed on the ground adjoining the transformer gallery to the east of the power house.

The power house is 60x30 feet, and is of the latest design, being constructed of concrete with corrugated iron roofing. The two side walls of the main building are re-inforced to support a twenty-ton traveling crane, which winds its way up and down the main room of the power house at the convenience of the operator. The water wheels consist of two 22-inch high pressure Victor turbines, which develop 1,000 horsepower. Directly connected with the main units are two 300 killowatt General Electric 50 cycle, three-phase generators. A Lombard governor, exciters, and all the other accessories that go to making the complete power plant, may be found in the installation.

Highgrove.

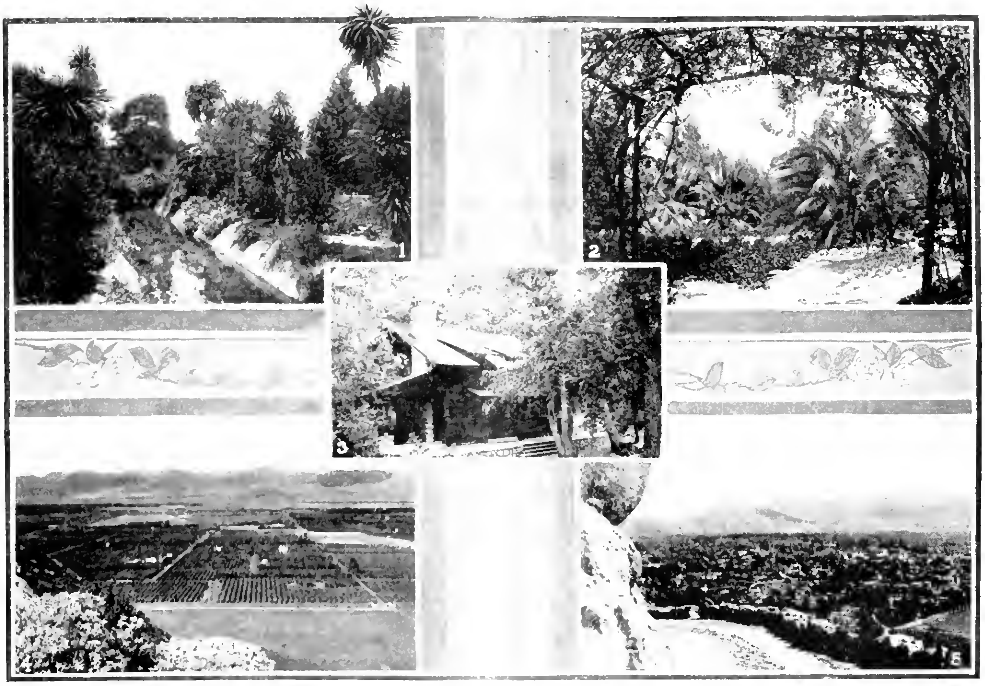
The Highgrove power house is ½ mile northwest of Highgrove, a suburb of Riverside. The intake of the canal is four miles above the power house, one mile east of Colton. A small concrete dam has been thrown across Warren Creek, one of the tributaries of the Santa Ana River. Fifty second ft. of water is then conveyed southward by means of a cement lined canal as far as the Santa Ana River. There it connects with a wooden flume which carries the water over the Santa Ana Wash to a cement lined canal on the other side, which extends southwesterly along the mesa to the small forebay 50 ft. above the power house.

In the power house is installed two 16-inch Stillwell-Bierce turbines, which operate under a 40-foot head. One 150 kilowatt General Electric generator supplies the electrical energy. Suitable transformers, exciters, and other necessary accessories complete the installation.

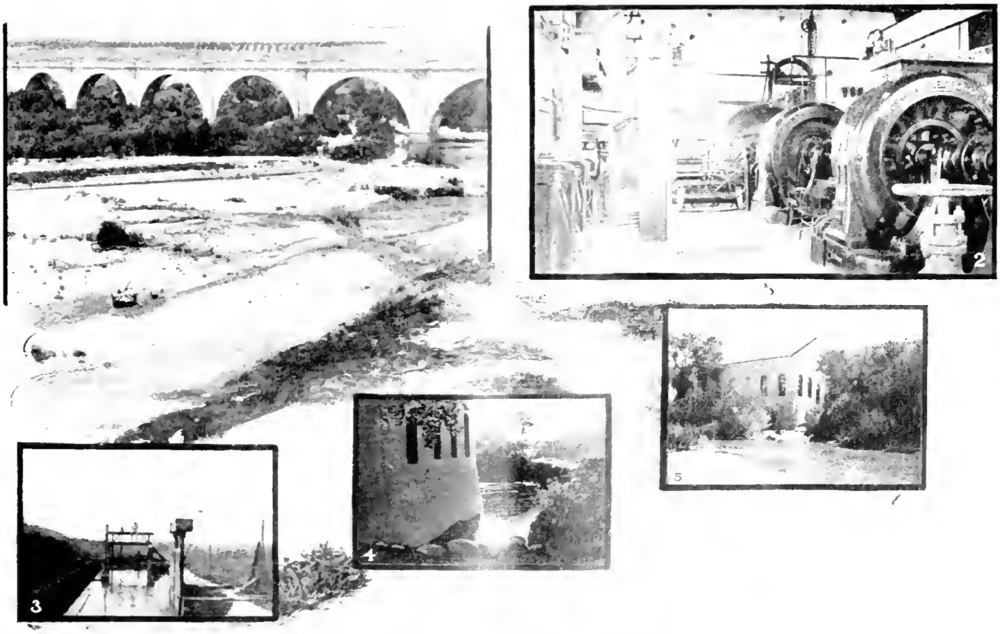
This power plant is unique in that it is located in the heart of the orange tree section and the merry hum of its water wheels seem in thorough synchronism with its happy surroundings.

The Santa Ana River.

The Highgrove and Pedley installations, as has been noted, both utilize the waters of the Santa Ana River. It will be recalled, also, that the Mentone plant is located on the same river. The Southern California Edison have two plants still farther up toward the headwaters. This brief resume of the economic use of the waters of the Santa Ana shows the highest state of hydro-electric development.



(1) Canal at Riverside. (2) Tropical Scene at Redlands. (3) Summer Home of W. G. Kerckhoff. (4) Summer and Winter Scene Near R[illegible]erside. (5) General View of Riverside.



(1) Intake Pedley Canal. (2) Operating Roo[illegible] (3) [illegible] (4) Tail Race. (5) Power House.

Substations.

University Substation.

THE Pacific Light & Power Company is engaged in supplying power to a country teeming in Spanish traditions. It is fitting, then, wherever conditions warrant, that the style of architecture should have a tendency to that of the mission make up.

The electric energy started at the Borel plant under an impressed voltage of 60,000, finally ends its weary journey at the Kern River substation in East Los Angeles. The sub-station is by far the most import- is located on Mission Road just east of East Lake Park. The throbbing transformers here installed are within hearing of the busy transportation line of the Pacific Electric Company. This company at frequent intervals sends its passenger-loaded cars humming along the short line between Pasadena and Los Angeles. This is one of the many ways in which it utilizes an enormous supply of electrical energy.

The structure is a modern three-story building constructed of reinforced concrete and fitted with the latest apparatus. In the distance can be seen the double-pole lines of the Borel station as they come over the vanishing point in the horizon. They finally enter by the orderly net-work found upon the third floor of the Kern River sub-station, each in a separate quarter. It is interesting to note the systematic manner in which the 15,000 volt terminals are brought up through their selector switches and thence to their proper buses. This Kern River sub-station might be thought of as the main artery supplying the life fluid to the entire system.

The Covina sub-station is an illustration of the standard design adopted by the company for this branch of installation. It is roomy, fireproof, and affords economic operation.

The University sub-station, situated in the southwest portion of Los Angeles, is an example of the neat and orderly design of some of the larger work of this class.

It is truly said that upon the economic distribution of the substations depend the final distribution of the dividends. The selection of the various locations for substations has been wisely made and each distributing district is located with its substation as nearly in its center as conditions of safety and design will permit.

The neat, trim appearance of the substations of the corporation located along the lines of the Pacific Electric Company add their portion in the gaining of the national reputation for efficiency enjoyed by the remarkable suburban electric lines of Los Angeles.

The tile roofing on the model substation—Covina—is certainly in thorough accord with the Spanish traditions which exert such a powerful influence throughout the whole of Southern California

Sunnyslope Substation.

Capacity of transformers, 2-250 kw.
Voltage transformation, 15,000 to 2400.
Size of transformer structure, 16 ft. x 24 ft.
Material and description of transformer buildlng, corrugated iron.

Physical Data for Third Street Substation.

Capacity of transformers, 6 625 kw., 4 250 kw., 2 250 kw., and 6 125 kw.

Voltage transformation, 15,000 to 2400 volts, 15,000 to rotary A.C., 15,000 to 5000.

Capacity and size of any rotary converters or motor generators giving types and makes, 1 400 kw., 2 225 kw., 220 v. D.C., 1 250, 1 400, 500-volt D.C. Westinghouse.

Size of transformer structure, 25 ft x 92 ft.

Material and description of transformer building, brick with iron roof.

Kern River Substation.

Capacity of transformers, 12 750 kw., 1 300 kw., 1 625 kw., 2 375 kw.

Voltage transformation, 50,600 to 15,000, 15,000 to 2400, 15,000 to 5000 volts.

Size of transformer structure: 1 room, 7 ft x 73 ft.; 1 room, 20 ft. x 8½ ft.; 3 rooms, 19½ ft. x 8½ ft.

Material and description of transformer structure, concrete with tile roof.

Covina—The Model Substation.

San Bernardino Substation.

Capacity of transformers, 3 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 24′ x 50′.
Material and description of transformer building, brick with iron roof.

Covina Substation.

Capacity of transformers, 3 37½ kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14′ x 47′.
Material and description of transformer building, concrete with tile roof.

South Pasadena Substation.

Capacity of transformers, 2 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14′ x 47′, with tile roof.
Material and description of transformer building, concrete.

Hollywood Substation.

Capacity of transformers, 3 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14′ x 65′.
Material and description of transformer building, concrete with tile roof.

University Substation (arcs only).

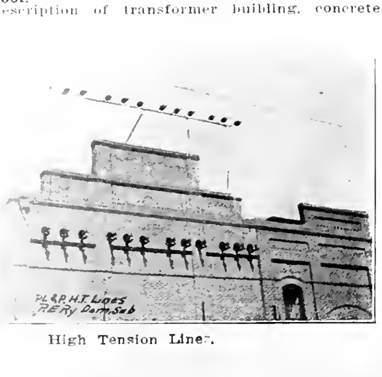
Capacity of transformers, 1 300 kw. and 1 625 kw.
Voltage transformation, 15,000 to 5000 volts.
Size of transformer structure, 33 x 40 ft.
Material and description of transformer building, corrugated iron and brick.

Huntington Park Substation.

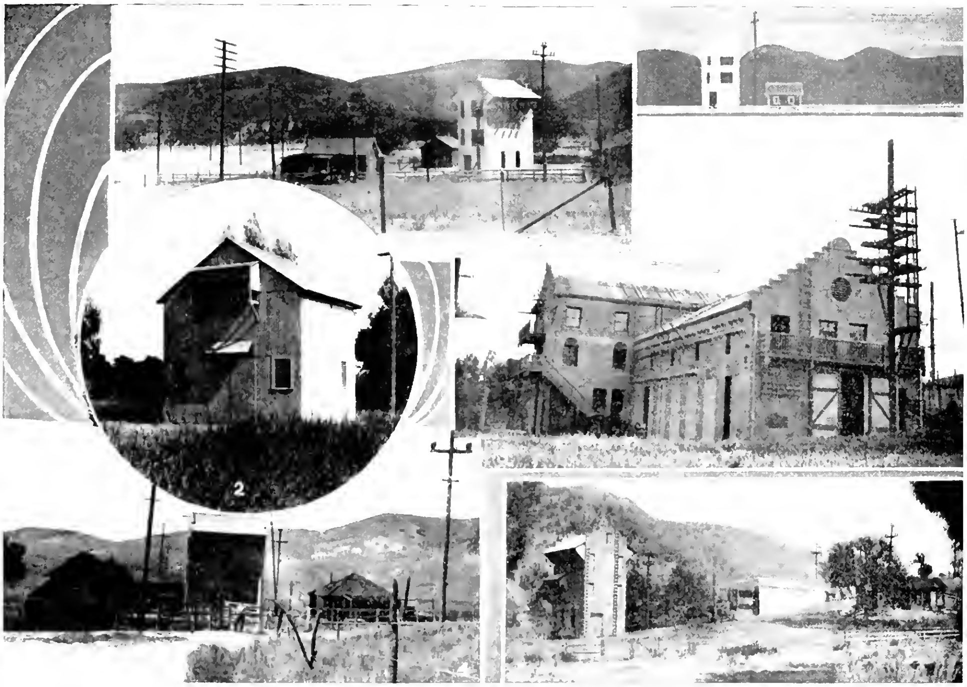
Capacity of transformers, 2 150 kw.
Voltage transformation, 15,000 to 2400 volts.
Size of transformer structure, 18 x 30 ft.
Material and description of transformer building, brick, concrete and corrugated iron.

South Pasadena Substation.

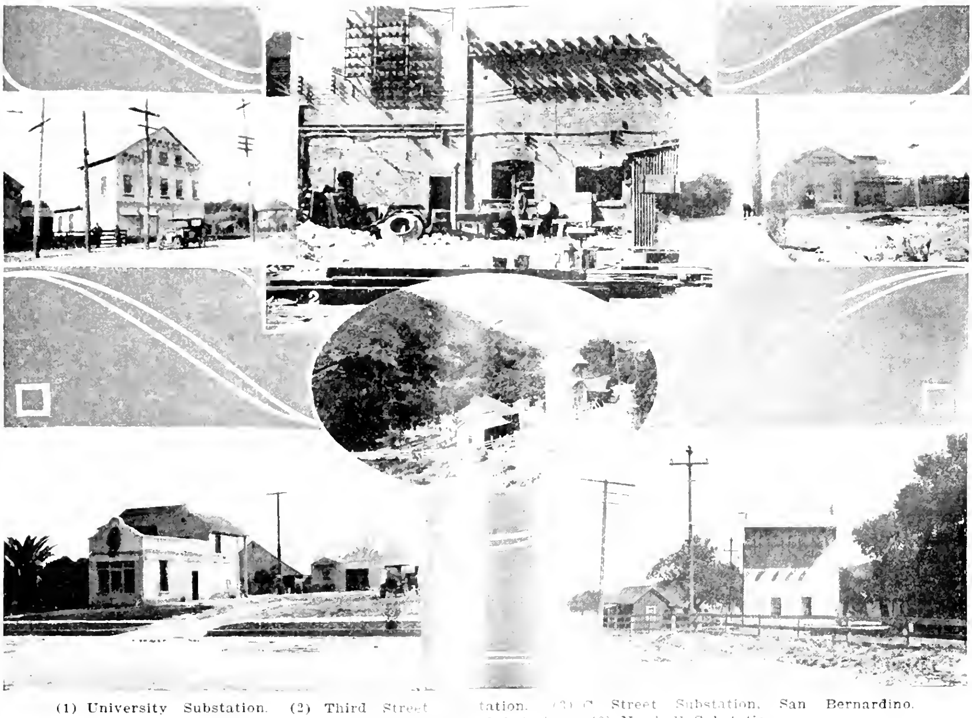
Capacity of transformers, 2 250 kw.
Voltage transformation, 15,000 to 2400 volts.
Size of transformer structure, 14 ft. x 47 ft. with tile roof.
Material and description of transformer building, concrete



High Tension Lines.



(1) Newhall Substation. (2) Sunnyslope Substation. (3) Kern River Substation. (4) Lake Substation. (5) Indian Substation.



(1) University Substation. (2) Third Street [illegible]tation. (3) C Street Substation, San Bernardino. (4) Oak Substation. (5) Pa[illegible] Substation. (6) Newhall Substation.

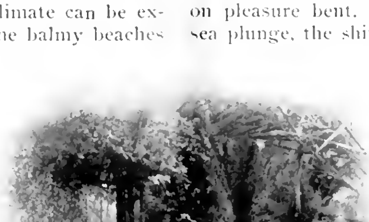
SOUTHERN CALIFORNIA.

St. Catherine's Well.

SOUTHERN California's charms have been painted by artists and sung by poets. It is not the purpose of this article to picture in highly colored paintings the beauties of this section of the Golden State, but rather by a few descriptive words to tell something of human interest to those desiring to know the facts about this much-talked-of section of California.

By a glance at the relief map of Southern California, shown herewith, it is seen first that this section of the state is hemmed in by the ocean on the west, the sun-lit deserts on the east, the mountain barriers on the north and south. Almost every condition of climate can be experienced within a day's ride. At the balmy beaches one can enjoy an ocean plunge in the dead of winter, and yet in the height of summer one may climb up into the high mountains and visit the perennial snows.

This section of the country is above all a livable place, and perhaps this fact, more than anything else, accounts for its remarkable and substantial growth during the last decade, a growth that is unparalleled in the census statistics of the U. S. Census Board.



Typical Scene at Redlands

The country is for the most part an arid section, requiring the scientific application of water to bring out the best results. For this reason no other place in the world presents such a high state of scientific irrigation as is to be found below the Tehachapi Pass. It is an old adage which reminds us that "time is money." In Southern California above every thing else "water is money." Mountain lakes have been reservoired, dam sites explored, and immense areas flooded. The underground waters of canyons have been tapped and utilized, artesian wells have been sunk, and pumping deep beneath the surface of the earth has been found most profitable. Such highly scientific development, however, is requiring enormous outlays of power. Such power applications comprise the most ideal load known to the economic operation of power plants, as electrically operated pumps running day and night know no peak loads. Hence the cheapest power rates are found most highly lucrative to the power plant owner. A scientific study of the trend of modern irrigation development points inevitably to these methods in almost inconceivable applications for future irrigation extension.

One not familiar with local conditions can hardly imagine without going from city to city in this wonderful section of the country the possibilities for concentrated ranching. A ten-acre tract is found to yield such results that only access to the carefully authenticated statistics can convince the investigator of unbelievable returns that are made possible. The untold areas that may be put under cultivation in Southern California make practicable for future extension the utilization of hundreds of thousands of kilowatts not yet developed or even in sight.

Perhaps in no place in the world are to be found better boosters or more people contented with their portion of life than those occupying the orange ranches of Southern California. The concentrated life on these ranches is pleasant, for by means of a lightning operated electric car service leading to a great metropolis, the rancher is practically a dweller in the city and yet posseses all of the open free-aired life of the country. Due to the enormous wealth per acre and the small acreages occupied, these ranches of Southern California present, perhaps, a greater amount of concentrated wealth per acre than any other section of rural life in the world.

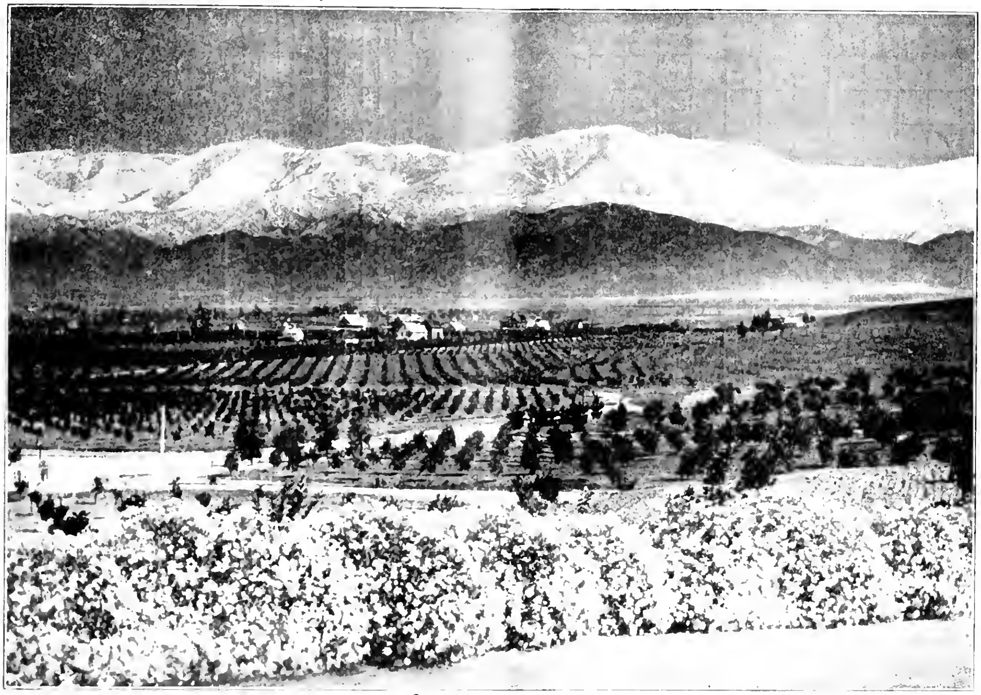
The easily accessible sea beaches add their portion to the enjoyment of the citizens of California. Every phase of enjoyment seems to be open to those on pleasure bent. The clear blue skies, the grand sea plunge, the ships far out on the horizon, the gray sage-brush spotted hills to the east, and the warm surf at the ocean's edge, add every touch of pleasure to one's outing.

Innumerable canyons thread their way up into the high mountains of this section of the country and form the pen-stocks down through which numerous water powers are developed. As one winds his way up in these canyons he is overcome with the exquisite beauty of it all. Proofs of the charms Nature lavishes here are the summer retreats of the wealthy citizens of this portion of the state. Many of these are tucked away in the picturesque coves along the canyon road. Although they are, perhaps, forty miles distant from the daily business cares of the owner, the week-end finds the automobiles chugging their way up the canyon from the busy city, bringing weary men to these havens of rest, and a brief two hours on Monday morning returns them once again to the busy hurly-burly of mercantile and industrial life.

Another feature which has added much to the development of this section of the country is its ideal climate. The remarkable evenness of temperature the year round is shown in the following list of the famed temperature resorts of the world, with it is a statement of the extremes of temperature to be found between January and July of each year:

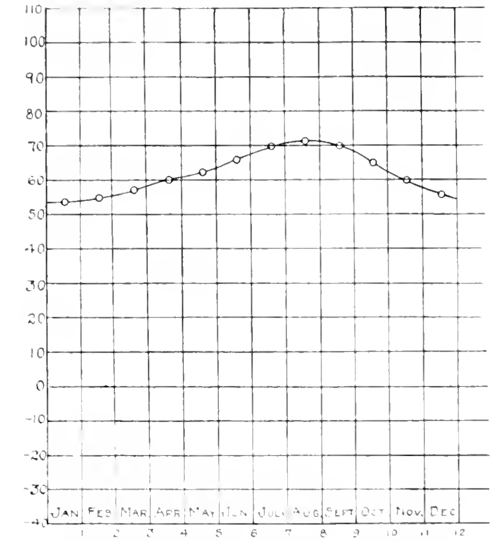
Melbourne	18
Auckland, N. Z.	19
Cadiz	19
Malta	22
Rome	25
Pensacola	27
Sacramento	27
Cairo	27
Jacksonville	28
Jerusalem	30
Nice	30
Naples	30
Los Angeles	15

Home Among the Oranges at Ontario.

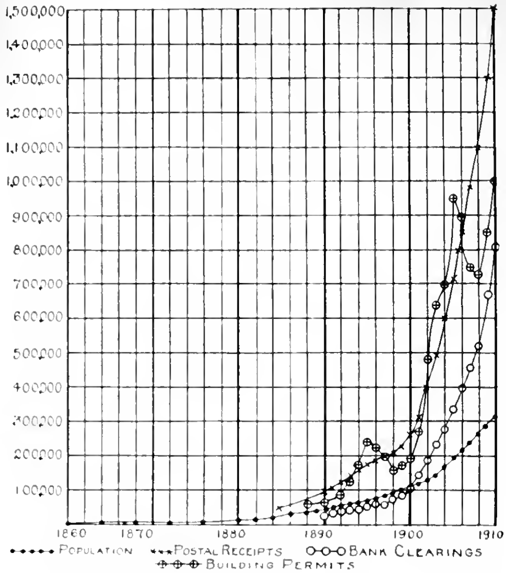


(1) A Striking Scene Typical of Southern Califor[illegible]—Marguerites in the Foreground, Citrus Fruits in all Directions and Snow-Capped Mountains in the Distance.

(1) Typical Southern California Mountain Ho[illegible] [illegible]) Summe[illegible] S[illegible] Beach Scene. (3) The Loud Roaring Pacific. (4) [illegible]k in a S[illegible]ded Canyon



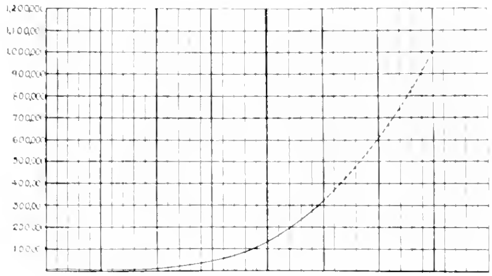
Remarkable Temperature Record of Los Angeles.



Financial Increases Even Outstrip Population Growth.

The accompanying diagram also indicates the average temperature month by month, experienced in this section of the country, according to the records of the last thirty-three years.

The Queen City of the southwest, Los Angeles, is remarkable for two features. The increase of postal receipts and population for the past decade is without a peer in the United States.



One Million Population in 1930—Law of Increase.

A diagram is shown herewith which illustrates this growth, and by extending the main curve along the dotted line according to the law of increase of population, shown by the unbroken line, it is seen that at the same rate of increase, it is reasonable to expect to find in this southern metropolis over 600,000 people in the year 1920, and in the year 1930 a population of 1,000,000 may be confidently looked forward to. Such indications seem incredible. Yet the next diagram shows that this increase in population has a substantial basis, for there is also platted to scale upon this second diagram the postal receipts, the bank clearings and the building permits. The remarkable thing is that as the population increases, all of the above commercial items increase at a far greater accelerating factor. Such an indication shows the stability with which this increase is taking place, and that a firmness and permanency of growth is going on with this unprecedented growth.

Los Angeles is remarkable for the energy and daring of its citizens. It is a place where they dream dreams, yet make good. As an example of the energy and enterprise of its citizens may be mentioned the Los Angeles aqueduct, which is the greatest municipal undertaking in the world. Pure mountain water is being brought a distance of 250 miles in sufficient quantity to supply a city of two million inhabitants. It is a gravity system throughout, no pumping plants being required. The aqueduct will deliver 258 million gallons (net) every twenty-four hours into reservoirs located nearly one thousand feet above the city. It consists of 98 miles of covered concrete conduit, 40 miles uncovered, 21 miles of open canal, 12 miles of inverted siphons, 43 miles of tunnels ten to thirteen feet in diameter, and 4 reservoirs along the line holding three months' supply. Bonds have been issued for this project to the extent of $23,000,000. The total cost will be safely under Chief Engineer Mulholland's estimates, and the work is rapidly rounding itself into shape for completion.

With a city growing at the most phenomenal rate of any in America, now having the enormous total of 360,000 inhabitants; with forty commercial and savings banks having a total capital and surplus of $23,672,429 and deposits amounting to $138,218,417 and annual bank clearings close to the $900,000,000 mark; with the nearby completion of the engineering enterprise of history which will divert with their wealth and enterprise thousands of strangers to her coasts, with an empire of arid lands awaiting the magic touch of water; with an international exposition proclaiming California's praises to the world; with an economic power supply nearby to meet her growing needs, surely a brighter destiny never awaited a growing electrical industry in a fairer empire.

MEMORIAL FOR INTERNATIONAL ENGINEERING CONGRESS

To the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Naval Architects and Marine Engineers, American Society for Testing Materials, Mining and Metallurgical Society of America.

Memorial and Report of Convention of Delegates held in San Francisco, January 15, 1912, to formulate plans for holding an International Engineering Congress in connection with the Panama-Pacific International Exposition in 1915.

Among the great engineering feats which have characterized the years of the last century and those thus far run of the present, there is nothing that approaches in magnitude and boldness the construction of the Panama Canal. When completed and in operation its effect on travel, commerce and navigation will be profound. As a factor in determining the character of the advance in civilization during the twentieth century, its influence cannot now be measured, but its potential importance is entering into all the arrangements for future commerce.

It is a signal honor for the United States of America that it has been permitted to serve as the instrument by which this great engineering work is to be accomplished. Perhaps in no other way could this nation have more significantly impressed its character on a work of world-wide importance.

In this great achievement, no class in this country is more interested than engineers, proud of the men in their profession who are bringing this great enterprise to a successful completion.

The determination to hold on the Pacific Coast an International Exposition to celebrate the joining of the two great oceans has brought to the engineers of the west a stimulating sense of the importance of the work of the engineer as a factor in carrying forward the march of civilization, and mindful of the inspiration and professional uplift to be derived from a concourse of engineers drawn from all parts of the world to one place and animated by one common purpose, they have committed themselves to the undertaking of bringing to the scene of this celebration representative engineers from the great engineering associations of the world in an International Engineering Congress to be held in San Francisco, and during the course of the Exposition.

In the full realization that this can only be accomplished through the various national societies acting in co-operation toward such end, the representatives of such societies in convention here assembled, beg to report with specific recommendations attached, such general plan of organization and management as seems best suited to accomplish the purposes in view.

The type of International Engineering Congress which this convention desires to recommend to the consideration of the national engineering societies which it here represents, may be viewed primarily as a series of meetings of the various American national societies with the participation or co-operation of foreign societies of similar standing, held in one place and with such relation or sequence in time as may best serve the convenience of those desiring to attend.

This type of Congress we believe to be the simplest in organization and the most practicable in its relation to the various interests involved. It will secure flexibility of general organization and, to the participating societies, the largest possible independence and responsibility, each in its own field of work.

Having in view a Congress of this type the part which would be taken by each national society in its individual capacity may be outlined as follows:

It will issue in its own name invitations to the foreign societies with which it is most closely affiliated and will be primarily responsible for the duties of host to such as may accept. At the same time such invitation might naturally be supplemented, should the inviting society so desire, by a further official or formal invitation from the Exposition authorities through the special Committee on Congresses.

It will in a similar manner invite, as it may desire, specially eminent foreign engineers to read papers or to take part in the proceedings.

It will be responsible for the procuring of papers, their examination, acceptance, translation where necessary, and printing previous to reading. In this manner each society, acting for itself and in its own field, will assume full responsibility for the scope and character of the papers which are presented under its direct auspices.

It will likewise assume responsibility for final printing and publication of papers with discussion, and as it chooses may effect such publication either as a part of its annual volume or as a separate publication.

These various duties and responsibilities relate to the participating societies individually and are not shared with any other committee or body.

Scope of Congress.

This Convention recommends that the scope of the proposed Congress, as determined by the number and character of the societies invited to participate, be determined by the seven national societies to which this report is primarily made, acting conjointly in such manner as may be hereafter determined.

Other Duties and Activities.

In addition to the preceding outline of suggested duties and activities inhering the national bodies themselves, either individually or conjointly, there will be certain further general duties and activities which must be shared among the participating societies or delegated in some measure to a representative committee.

Such duties may be briefly noted under the following three heads:

(1) Local Committee Activities.

(2) General Publicity.

(3) Social Events, Excursions and like attentions to foreign visitors.

It is clear that in carrying to a successful issue an undertaking such as the proposed Congress there will

be required a strong and widely representative local committee.

This convention recommends that the nucleus of such a local committee should consist of an executive committee comprising three representatives from each of the participating national societies, such representatives to be appointed by the Council or other appointing power of each society, having in view such nominations or suggestions from its local members or branch as they may desire for their information or guidance.

The general duties of such a committee are sufficiently evident from its name. It will have no authority to speak for any national society except as it may receive direct authorization to do so. It will serve primarily as a link between the Exposition authorities and the various national societies, and will in general endeavor to correlate all efforts and interests of a local character toward the success of the undertaking.

Program of Meetings.—Each society will naturally prepare and be responsible for the program of its own meeting. It will be desirable, however, to secure something in the nature of a program of meetings, simply to insure the entire series with a reasonable total time of perhaps fifteen days, without lost time, and in such sequence or concurrence as shall be mutually most agreeable.

Such arrangements would most naturally be made through the local executive committee acting as an intermediary between the various societies and the Exposition authorities, and as a general clearing house for all such matters as may affect the various societies in a collective sense.

Joint or Mass Meetings.—While papers generally will be presented under the auspices of the society which has secured their preparation, it is not unlikely that it may seem desirable to hold certain joint or mass meetings or assemblies at which distinguished foreign engineers or others may have the opportunity of addressing a larger audience than might attend the meetings of a single society. It may seem desirable to open the Congress with some such meeting.

Such details may readily be arranged by the suggested local executive committee, which will act in this regard, as in all others, on behalf of such groups of societies as might desire to make such arrangements.

Publicity.—Regarding publicity, the local committee will naturally be expected to look after such part of this program as may relate to the Pacific Coast in general, California, San Francisco and the Exposition itself.

In addition, each national society will naturally take such steps both officially as a body and individually through its members, as may serve most effectively to bring the matter to the favorable attention of its own members throughout the country, and in particular to that of such foreign societies as it might naturally be expected to invite.

Social events, excursions, etc., will naturally be arranged by the local committee, acting, however, in co-operation with the various national societies, and as their direct agent in the case of any special arrangements which they may desire to make.

Finance.

The various participating societies will naturally provide, each in its own way, for such expenditures as may be necessary to carry out its own individual part of the program as outlined above. In addition, there will be need of certain general funds, especially for the activities of the local committee.

This convention does not recommend any specific plan for providing such funds, believing that it may be safely left as a detail to be later determined, in case the proposed outline plan of organization secures general approval.

For social events, excursions, etc., it will be necessary, presumably, to depend largely on private contributions. This also is a detail which is left for later consideration.

Time of Proposed Congress.

This convention has considered carefully the question of the time of year most suitable for the successful holding of a Congress such as that proposed, and begs to report that in its opinion the month of September (more exact dates to be later determined) will prove the most acceptable both as to climatic conditions and the general personal convenience of those who will desire to attend.

Assembly Rooms for Meetings.

This convention has received through representatives of the Exposition authorities, authorized to speak for its President and Board of Directors, full assurances regarding the adequate provision, free of all expense, of suitable assembly rooms, convention halls, etc., as may be required for a Congress such as is herein contemplated.

These assurances in written form are contained in a letter addressed to the convention by the Chairman of the Board of Exposition Directors and fully empowered to give to this convention assurances regarding such assembly and meeting rooms, and regarding the cordial co-operation and support which the Exposition authorities will extend to such a Congress within the limitations indicated in this communication, a copy of which is hereto attached marked "A".

In conclusion, this convention desires to report and to recommend to the national societies here represented in brief, as follows:

(a) It is the sense of this convention that it is highly desirable to hold in San Francisco in the month of September, 1915, an International Engineering Congress.

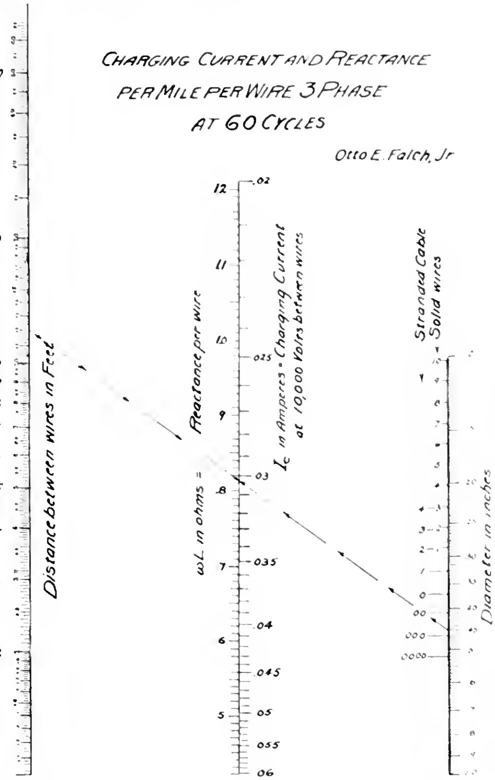
(b) It is the sense of this convention that the general plan of organization and management herein outlined is that which will prove best adapted to this purpose, and such plan is therefore recommended to your favorable consideration.

(c) Should such outline plan meet with your approval this convention begs to recommend prompt action on the appointment of the proposed local executive committee as herein suggested, and early consideration of ways and means to provide for the clerical help and other expenses necessary to make its work effective.

SIMPLE METHOD FOR FINDING TRANSMISSION LINE REACTANCE.

BY OTTO E. FALCH, Jr.

The accompanying chart gives a rapid method for finding the charging current and reactance of transmission lines. It consists of four scales, one showing the distance between the wires in feet, one showing the reactance per mile, one the charging current at 10,000 volts between wires and the last the various sized copper wires, whether standard cable, solid wires or hemp core cable. The arrow lines show that a .45 in. hemp core copper cable with a 12 ft. spacing has a reactance of 8.15 ohms per wire and a charging current of .0303 amperes per mile of 10,000 volts.



For a 104,000 volt line 136 miles long the reactance consequently becomes 111 ohms and the charging current 42.8 amperes at 60 cycles per second, the equivalent of 7730 kilowatt amperes. Other problems are similarly solved by connecting a straight line from the size of wire to the spacing and finding the values sought at the intersection.

This chart is a modification of that published in the Feb. 10, 1912, issue of this journal.

Splicing the Pacific Cable, which snapped on the reefs off the Midway Islands, is to be tried by the British cable steamer Restorer, which left Seattle this week. At Honolulu a crew of Kanaka divers with their surf boats will be taken aboard to assist in the difficult task of grappling for the cable.

THE POSSIBILITIES OF CO-OPERATION.

BY PHILIP S. DODD.

During the great Jovian celebration at New York City, Philip S. Dodd, director of publicity of the National Electric Lamp Association and secretary of the Commercial Section of the National Electric Light Association, outlined briefly the work which had been done and which was being done by the Commercial Section, mentioning the value of the reports which had been prepared by the Commercial Section Committees last year, and the value of the two publications, "Data on Electric Signs" and "The Electrical Equipment of the Home" for the development of the industry along educational lines, and their value as a force in the education of the public concerning things electrical. He explained that the plans of the Commercial Section for the coming year embodied the preparation of at least three other publications along similar lines, which would be prepared for general distribution to assist the central stations and manufacturers in the development of their business. Also that the plans of the Section embodied the compilation and distribution of a "Cumulative Commercial Index and Digest" for the benefit of the commercial men in the industry. The digest to contain a complete catalogue of current consuming devices together with data relative to their various constructions and installations, and abstracts and digests appearing in the technical press.

Also that the Section had planned for an advertising exchange which would give to its members the best thought in the country pertaining to advertising and developmental campaigns for use of business-getting departments.

With regard to the New York Jovian Luncheon meetings and various other local organizations of similar character, he made a strong plea for the commencement, by these organizations of definite, practical work for the development of the industry as a whole, illustrating forcibly that where organizations of this character were conducted along the lines of merely passive co-operation, that the interest in these organizations was apt, in the course of time, to lag, but that in each case where active, aggressive work had been taken up, the organizations were not only of much greater value to the industry, but that the interest and enthusiasm was retained and greatly strengthened.

He suggested, and the suggestions were later carried out, that two committees be appointed for the commencement of real work; one the ways and means committee to prepare plans for the definite organization in the City of New York, and a further committee to take up and start, if possible, the co-operative electrical page.

The largest Diesel engine yet built for stationary work is that of 2000 to 2400 horsepower, manufactured by Sulzer Bros. of Winterthur, but it is now stated, however, that an order has been placed with the same firm for four 4000 brake-horsepower engines destined for electric driving in Chile. These will be of the six-cylinder type, working on the two-cycle principle, and their design will be practically the same as that of a marine engine of the same power without the reversing gear. Crossheads will be employed, and it is intended that the engines shall be rendered as simple as possible.

WATER POWERS.

BY. J. C. RALSTON.

In the course of an address delivered before the Northwest Mining Convention at Spokane, Wash., February 15th, 1912, are forcibly stated some plain facts about the Federal resistance of water power development in the West.

It is our purpose to briefly inquire into the theory underlying the use of this great National asset, and into the perversion of that theory as we now unfortunately find it.

The Congressional Act of 1866 throwing the public domain open to mineral location, the Pacific Railroads Bill, the great territorial acquisitions to the United States, the Public Land Laws and the Carey Act were all based upon the theory of encouragement and national development.

It was not until this great group of Legislative Acts made its vitalizing influence felt throughout the country that the nation put away its swaddling clothes and stepped full-panoplied into the arena of world powers. It was not until the fruits of such an internal policy were gathering that the Nation put its monetary system, like the other great nations, upon the gold basis. It was not until the Pacific railroads fostered and encouraged by the Federal Government, were in their fullest operation, that it was possible to enforce the otherwise inert Monroe Doctrine. It was not until our mineral resources were copiously producing that the the Nation could remit a Boxer Indemnity; not until our lands and forests were intensively producing that we could come forth as a champion of the weak and compel Spanish righteousness. It was not until a splendid measure of National prosperity prevailed, attaining its fullest magnitude when National encouragement flourished, that it was possible for an American Navy to circumnavigate the earth.

Amongst the logical incidents of a universal Western development came the need for mechanical power. Coal there was in plenty throughout the Eastern and Middle Western States; but the measures of the West were less plentiful and less pure. Nevertheless, what the Western States seemed to lack in accessible coal reserves was munificently made up in a vast number of great natural water powers. If the laws of Congress were the means of creating a colossal empire of agricultural and other industries, not the least of those industries being power, then it must follow, unless the Nation is to stultify itself, that this water power industry must be developed upon the same theory as were the primal industries from which it sprang. Not that this industry, as such, is a child in need of special or privileged encouragement, but since its development is as essential to the fullest well-being of the West as a dependable fuel supply, it cannot and will not develop under the blighting theory of discouragement and strangulation. The industry promises to become, indeed has already become, one of the important links in National development.

The necessity for economical power is tantamount to the necessity for economical transportation. Power, like transportation, cannot be doled out with a wheelbarrow, but only by the aggregation of large plants economically operated and permanently built upon permanent titles, safeguarded in their rights and encouraged by intelligent and unwhimsical laws, can they meet the demand which a growing country must require.

If hydro-electric power usurps a part of the field which coal previously served, that usurpation is benign and is the highest form of conservation because the coal is saved and the wasting waters are put to beneficial use. If the coal measures of the Eastern States feel aggrieved, and are suffering for a Western market, well and admirably must their hopes find encouragement in the present bureaucratic restrictions upon Western power sites. But perish the thought—it is untenable. Yet curiously by an innocent corollary, the less water power there is on the market the greater must be the demand for coal and oil. It is an historical fact, incidentally, that the Western and Alaskan coal fields not already patented may not be developed excepting under formidable Federal restrictions. Thereby follows another embarrassing corollary; the market for the coals that are now produced from patented lands is daily expanding, while prices are foolishly sympathetic with demand. Furthermore, it is a noteworthy coincidence that the private owners of coal and oil lands generally are active and outspoken in their approval of the withdrawal of all public domain on which coal and oil are known to exist. If the present policy of the alleged conservationists tends to restrict the rival fields of production or to create a handicap upon such production, it needs no economist to translate that important fact. If the same policy seeks to further establish a handicap upon water powers,—an admitted rival of privately owned coal mines and oil fields,—then we secure a clearer vision of the political conservationists' desire for Federal strangulation.

The permanent administration by the Federal Government of water powers or public lands in a State, sovereign as to all functions except those which were delegated to the National Government, is an interference with State affairs never before attempted. Such an attempt must result in a carpet bag bureaucracy, obnoxious and putricent.

In this country the fundamental basis of law is that the States have all the sovereign power which they have not surrendered expressly or by implication to the National Government. In the matter of waters the only power surrendered to the National Government is the control of the navigable streams for the purpose of maintaining and improving their navigability for the benefit of interstate commerce. The Supreme Court has time and again determined that the waters belong to the States and not to the National Government. In accordance with this principle every arid State in the union has enacted laws governing the use of water for irrigation and power purposes, and the Supreme Court has sanctioned such laws. It has held that such laws have always been in existence as laws of necessity.

The man who first applies the water to beneficial use for irrigation or power is universally recognized as having priority of right to the flow of that water. The Federal officials now recognize the ownership of the water in the States, but in order to secure jurisdiction they claim that inasmuch as the Government owns the lands lying along our streams they will not grant a permit or right of way to a power company

to conduct the water over that land and by a sharp descent send it back to the stream, thereby generating power, unless the owner of such power plant agrees to pay a royalty on the water and until he agrees to certain other discouraging bureaucratic terms. This is simply doing indirectly what the Government cannot do directly. It is annulling the inherent power of sovereignty in the States called Eminent Domain, by which rights of way can be condemned for public enterprises.

Under the guise of Conservation the political conservationists have so grossly misrepresented the facts that a credulous public has come to believe that the theory and policy of our Government should be entirely reversed; that the title to water powers, coal, oil and phosphate lands should be held in perpetuity by the Government, and that the right to exploit them should be through leases. There is just as much reason why they should include agricultural lands, but they well know that such an attempt would mean political oblivion to the Palladine of Conservation.

Among the proposed bureaucratic terms, certain Federal taxes are now fixed by the permits for the use of State waters. Time will not now permit of a full discussion of those taxes, but a few of their salient features may with propriety be pointed out. The terms of the permit impose a tax upon the output of the power plant. This tax is so ingeniously devised that if a man installs a highly efficient plant he must pay a higher conservation charge than the man who wastes water by the installation of a cheap, inefficient plant. Furthermore, the man who sells power at a low price must pay a greater tax than the man who sells at a high price. The man who transmits his power over long distances, as is so generally done in the West, must pay for all his transmission losses and therefore pays a greater tax than the man who sells his power at home. This leaves centers remote from water power to turn to other and perhaps much more expensive means, thus stultifying the theory of National Development. Again, if "forest control" adds 25 per cent to the value of water power, a tax of 4.2 per cent of the gross receipts is a tax of 21 per cent of the gross value contributed by the forest. These figures of taxation are cited by Mr. Lewis B. Stillwell, past president of the American Society of Electrical Engineers, as fairly typical within the schedules now demanded. Any yet this new Heaven and new Earth are announced from Washington with the same irresponsible nonchalance as if our Napoleons of Conservation were buying a five-cent cigar.

It must therefore be evident to him who runs that whereas by virtue of a benign and fostering policy on the part of the Federal Government, wherein the boundless West leaped from infancy to adolescence under the theory of encouragement and National development it now finds itself struggling for life under the antithesis of that theory which is expressed by discouragement and strangulation.

While it is too often customary in these days of Bureaucratic Nostrums to condemn without offering reconstruction material, the speaker desires to offer as a substitute for the present form of "Power Agreement" now enforced by the Forestry Service, the following:

1. The Government should make grants to responsible parties on an intermediate franchise plan similar to that adopted by the State of Wisconsin for franchises for public utility companies. This would be a grant practically during good behavior,—the question of good behavior to be subject to review by the courts only. The Government should retain the right to regulate service and rates, in case the State in which the property lies neglects to provide for such regulation. Probably where the property lies within more than one State, or where the business served is interstate business, the Government should retain jurisdiction in its own hands. This plan will accomplish all that the advanced conservationists can hope to do, while at the same time making it possible to obtain private capital for such enterprises.

2. No rental should be charged for the concession. The reason for this provision is that in the first place if the enterprise is able to pay a rental it should take the form of a reduction in price for the power sold, which gives the benefit directly to the consumer, whereas if a rental be charged it becomes an indirect tax upon the consumer for the benefit, not of his community, but of the Federal treasury. The people of the West feel that in view of the fact that practically all eastern water powers are in private hands and pay no taxes to the Federal treasury, the West should have the benefit of its water powers for the localities in which they exist.

Where streams are improved at the expense of the Government or State, the power should be reserved to the Government to assess the power companies occupying sites upon the river affected, for the reasonable benefits conferred by said Government improvement, the assessment to take the form of an annual interest charge payable to the Government or State.

It would probably be desirable to extend this last named feature to the extent that if a private corporation makes an improvement upon a stream which will benefit not only its own property but other property upon the stream, some means should be had of compelling the sharing with it of the cost of said improvement among the other parties benefitted.

It might be provided that in case the lands thus granted shall later be required by the Government for its own use, that the grantees be compensated for the reasonable value of the improvements which they have made upon the sites, and for such improvements as they have made which, while not situated upon the Government sites, are nevertheless, dependent upon said site for their usefulness, as an example, transmission lines connecting the power plants built upon Government sites with the market which they supply, whose usefulness would be entirely destroyed if the site were compelled to be abandoned.

A comparatively short term of franchise on any such sites should not be seriously considered as they will undoubtedly stand in the way of the development of the power resources of the country, and the sinking fund necessary for the retirement of the capital invested within the term of short-term franchises would add so materially to the cost of service to the consumer that it would be very objectionable, and it seems to me altogether unnecessary.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Business Activities

The recent published list of bank clearings of the coast cities as compared with those of a year ago indicate that an enormous increased volume of transactions is taking place somewhere in the West to cause all this money to change hands. Unquestionably the early future will see a marked betterment in coast conditions. The eternal sound of the Panama canal shovels, eating their way through the connecting link of two continents, serve but to warn us all of the near approach to completion of this project of the ages. Somebody, somewhere, must get busy and the wise ones on the coast are preparing to spike their share in the new commercial readjustment.

The Call of the Engineering Societies

An enterprise, having for its purpose the nation-wide celebration of the completion of the greatest engineering undertaking known to the civilized world, may well entertain the highest ambitions and aspirations. So peculiarly significant of the project it commemorates, is the holding of an international engineering jubilee at San Francisco in 1915, the memorial to the great national engineering societies, found elsewhere in these columns, is certainly fitting and timely.

The American Institute of Electrical Engineers has already taken definite and positive action in the matter of holding an international electrical congress at San Francisco during September of 1915. It is to be hoped that the other societies will take similar action at an early date.

The proposal set forth in the memorial outlines a method of committee representation for a general inter-society conference, which is complete and should prove effective in every respect.

A little over two years and a half now remain before the Panama-Pacific International Exposition will be in full swing. Engineers, the world over, must be communicated with in the planning of the program for this great gathering. Months must be spent in the preparation of papers after the noted speakers are engaged. In the absence of the proposed world's greatest wireless station at San Francisco, it is to be hoped that, although slower speed is necessitated in delivering the invitations, force will not be lacking in bringing about an immediate and definite affirmative answer to this urgent invitation.

The Electric Motor Truck

The recent announcement that the largest automobile company in the world is to build immediately in California a branch factory that will cost $300,000 and be capable of turning out 5000 machines a year is interesting to coast engineers. The West seems to figure in the rise of all great industries of the day. The citizens of California possessing within their borders over one-tenth of the

automobiles of America, may well be wooed by these great interests.

The automobile as a pleasure giving mechanism is unquestionably in a class by itself. But the other side, the commercial end, in which the electric motor truck is beginning to play such a leading role in the congested districts of our western cities, is the phase which so deeply interests at present those of us who are engaged in affairs electrical.

The recent San Francisco meeting of the Electrical Development League was of much interest to all those either taking part or listening to the discussion. There was no point brought up, however, of more intense interest than the announcement of Geo. C. Holberton, general manager of the San Francisco Gas & Electric Company that parties stood ready to pay an amount of money equivalent to 16 per cent on the investment for any one who would furnish $45,000 to purchase electric motor trucks for the use of a certain firm in San Francisco.

New uses and new industries are constantly arising which each day give broader applications for sale of electrical energy. None, however, are more promising than the rapid rise of the electric motor truck.

The Relief of the Earth-Bound

The water-fall with its bountiful provision for human needs delights and touches the heart of man with a beauty indescribable—a beauty not of a picture painted on canvas but rather a beauty which enters the innermost recesses of human yearnings and longings where dwell those qualities that entune man with the Infinite.

Such a beauty overcomes the power expert when he views from some point of eminence the hundreds of miles of drainage area, feeding the rushing rivers which hurry onward in their flight to the loud roaring Pacific. The deep canyons no longer appeal to him as mere masterpieces of nature for ornamental use, but now he sees in them prospective tunnels, overhanging flume lines, siphons which will cross the intersecting canyons and a thousand other engineering structures which will aid him in harnessing these untold powers and making them of use to his fellowmen.

One of the characteristics which distinguish the human being from the other members of the vertebrate family—the ox, the cow and the ass—is man's ability to utilize the forces in nature and make them obey his will and pleasure. The followers of Zoroaster in the early dawn of history, inspired by the seeming inherent divine powers of the flame, worshipped the heat-giving fire as an ever-present god. The Phoenicians, in their wind-propelled ships, sailed the unknown seas, thereby gaining for their civilization prowess and world knowledge. The great powers latent in the falling of water have, however, in order to bless mankind with their presence, awaited the modern development of electrical transmission of energy.

The mere question of being able to harness these powers and deliver them at a profitable figure is to the true engineer but a side issue. It is rather the thought of being able to utilize these waters over and over again for hundreds of years to come that holds him spellbound in his work. As he straps on his high-legged boots and throws his mountain transit over his shoulder, he dreams these dreams and, as the packtrain with its burdens securely fastened by the "diamond hitch," trails its way up through the long winding canyons to the distant reservoir lakes above, again he dreams of the good he will be able to accomplish for his fellowmen. The beauty of it all is that no matter how many water powers he harnesses, no matter how many canyons he reservoirs, like the widow's cruse of oil, his power supply will never diminish, but year after year continue to pour its blessings in the way of light, heat, and the other comforts into the heart throbs of the busy business centers a hundred miles away.

The last ten years have added a new impetus to western life. No longer our young men from the eastern colleges and universities flock out to the mountain ranges and deep valleys for the purpose of sifting the sands for gold. Now comes a stronger, sturdier class of prospective citizens, young men ambitious to be factors in the development of the great waterpowers of our Western Empire. From snow-capped Mt. Rainier in the north to our sun-lit deserts in the south, our mountain districts seem to be teeming with these young men. The result is that every crooked turn in our rivers, every waterfall with its rainbow hue, every mountain lake with its wild game and fish, has been explored, mapped, and reported upon as to future power possibilities.

The granite reef a mile through its heart, the overhanging cliff studded with rocky pinnacles, and the desert with its burning sands have seemed to offer no obstacles to the advance of the great trend of power development.

Many have said there is no study more sublime than astronomy, which tells of worlds millions of miles away. Yet as we gaze upon the masterpieces of engineering accomplishment, of rocky dams running into the hundreds of feet vertical, tunnels conveying water five miles through the rocky pinnacles, flumes constructed along sheer cliffs, pen-stocks, taking their waters from a point almost invisible in its vertical distance above, we are overcome with the awe-inspiring accomplishments that confront us.

A celebrated artist, in his endeavor to portray the burdens and cares of the human race, painted a picture more eloquent than words, setting forth the manner in which every member of the human race is held bound to the earth. His painting is called "Earth-bound" and pictures the old man, the young man, the woman and the child supporting a crushing weight, which pins them to the earth. The men are endeavoring to share the child's part of the crushing burdens and in a measure to share the woman's while the woman is also supporting her share of the burden and endeavoring in addition to share the child's.

No artist can picture the influence the harnessing of the subtle forces of nature is having upon the human race, nor can he point the extent to which its burdens are now being alleviated. Suffice it to say that it requires no stretch of the imagination to prophesy that with the highest development of the water fall and its captive power will eventually come the relief of the "earth-bound."

PERSONALS.

C. C. Cooley, representing a wire manufactory of Trenton, N. J., is among the recent arrivals at San Francisco.

C. C. Hillis, Pacific Coast branch manager of the Electric Appliance Company, has returned to his headquarters at San Francisco from the East.

Samuel G. McMeen, general manager of the Mount Hood Railway, Light & Power Company, of Portland, spent the past week at San Francisco.

F. O. Blair, formerly with the Missouri Pacific Railway Company, has been employed by the city commission of Chehalis to act as city engineer.

C. E. Greesbeck, who represents the Western States Gas and Electric Company, with headquarters at Portland, was a recent San Francisco visitor.

S P. Russell, manager of the electrical department of H. W. Johns-Manville Company's San Francisco branch, has returned from an Eastern trip.

R. Leo Van der Naillen, general manager of the Oro Electric Corporation, is at Oroville on business connected with the proposed hydroelectric development.

F. D. Gleason, manager of the San Francisco branch of the Western Electric Company, is at Seattle to meet Mr. Bennis, an official of the company, and accompany him to California.

P. H. Affolter, manager of the electrical department of Fairbanks, Morse & Co.'s San Francisco house, has returned from an extensive Eastern trip, in the course of which he visited the various factories.

Charles W. Waller, who is interested in the California Consolidated Light & Power Company, which operates electric power and traction plants at Monterey and Salinas, is at New York City on business.

John Coffee Hays, general manager of the Mount Whitney Power Company, arrived at San Francisco, from Visalia, during the past week, in company with John Hays Hammond, with whom he is interested in hydroelectric enterprises.

Among the San Francisco electrical representatives who recently visited Los Angeles on business were: Miles Steel, of the Benjamin Electric Company, H. B. Squires of Otis & Squires, and S. B. Gregory of the Arrow Electric Company.

H. E. Grant of the British Columbia Electric Railway Company, recently delivered an inspiring address on "Some Notes on Opportunity in the Electrical Industry," before the Vancouver Section of the National Electric Light Association.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, returned to San Francisco during the past week after a business tour of Southern California. He expects to start something among the Rejuvenated Sons of Jove very shortly.

Arnold Pfau, hydraulic engineer for the Allis-Chalmers Company, who recently arrived at San Francisco, has gone to the Seattle office of the company and will make tests of the new hydroelectric plant of the White River Power Company at Sumner, Wash., before he returns to California.

J. J. Pottinger, formerly sales manager with the San Francisco offices of the Westinghouse Electric & Manufacturing Company, has become sales manager of the Mechanical Installation Company of 189 Second street, San Francisco, who will specialize on electrical construction and repair work, as well as second-hand electrical machinery.

H. L. Jackman, general manager of the light and power interests of the Western States Gas & Electric Company in Humboldt County, spent the past week at San Francisco purchasing steam turbine equipment for the Eureka generating plant, which is to have its capacity doubled at once. The contract for additional condensing apparatus was awarded to Hunt, Mirk & Company.

John Martin, who is interested in the Coast Counties Power Company and the Midway Oil Company, has returned to San Francisco from New York accompanied by Mrs. Martin.

Herman von Shrenk, formerly of the forestry department, at present a consulting engineer of St. Louis, a leading authority on creosoted wood pavement, has been spending a few days in Tacoma in connection with the creosoting plant to be erected by the St. Paul & Tacoma Lumber Company.

PACIFIC COAST A. I. E. E. NOTES.

The Portland Section discussed "Preservative Treatment of Poles" on February 20.

The Los Angeles Section discussed "Gas Power" with special reference to the gas producer on February 20.

The San Francisco Section considered "A Cable Crossing of San Francisco Bay" on February 26.

The Board of Managers has granted the request that a Branch be established at the University of California.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

The John G. Sutton Company are doing the electric work in the Nickle residence at Sacramento and Laguna streets for $1920. Henry Meyers is the architect.

Seth Cohn, a popular electric contractor of San Mateo, had his collar bone broken when his horse ran away last Sunday. He is doing as well as can be expected, but will be confined to his home for some time.

The Turner Company have been awarded the electrical work on the building on the south side of Geary street, between Polk and Larkin, for the Sheehy estate, according to plans and specifications, for $2600.

The power committee of the California State Association of Electrical Contractors meets at Bakersfield Sunday, February 25, to discuss ways and means of bringing closer relations between central stations and contractors for the mutual benefit of both.

The findings of this committee will be forwarded to the executive committee of the National Association of Electrical Contractors, which body will early in March meet a committee from the National Electric Light Association.

The members of the power committee are John Rendler, Los Angeles; H. Miller, Pasadena; J. R. Reynolds, Santa Barbara; Seth Cohn, San Mateo; Phil Levy, San Francisco; C. V. Schneider, Sacramento, and W. S. Hanbridge, San Francisco.

The California Electrical Supply Company, Roy A. Wolden, manager, has removed from 680 Mission street to a new store at 643 Mission street. The California Electrical Construction Company, R. L. Wolden, manager, will remain at its present location, 680 Mission street, San Francisco.

The following notice was mailed to contractors' offices by Wm. J. Nixon, chief of department of electricity, San Francisco, in reference to use of code wire: "This department will rule that, unless work is started on job on or before July 1st, 1912, nothing but new code wire will pass inspection, irrespective of what date application is filed."

TRADE NOTES.

Ray D. Lillibridge, incorporated, technical advertising experts, at New York City, announce the acquisition of the services of Kingsley Gould Martin as engineer and writer. Mr. Martin has secured a substantial interest in the corporation and has been elected its treasurer.

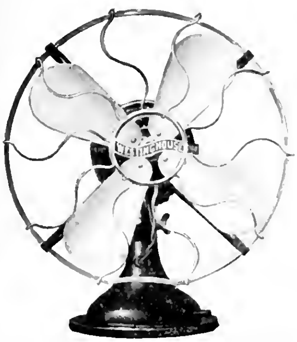
The Standard Underground Cable Company, with Pacific Coast offices in the First National Bank Building, San Francisco, have opened additional sub-offices in the Central Building, Seattle, in charge of C. A. Brown, and in the Yeon Building, Portland, in charge of W. G. Stearns.

INDUSTRIAL

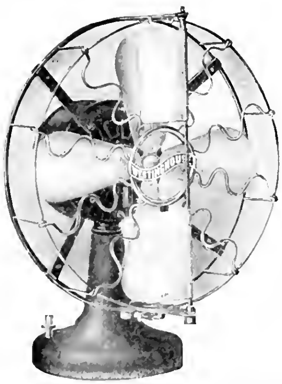
NEW WESTINGHOUSE STEEL FRAME FAN MOTORS.

The introduction this year by the Westinghouse Electric & Manufacturing Company of a complete new line of fan motors with steel frames instead of the usual cast iron construction, bids fair to mark an epoch in the history of the manufacture of a product already having reached such a degree of perfection that further improvements were considered to be only of minor importance.

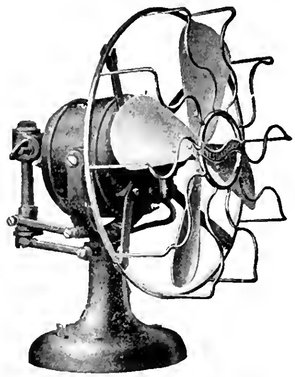
The motor frame, the base and the guard arms are made of drawn steel, instead of cast iron which has been the usual practice for years. Drawn steel combines great strength with minimum weight; these fan motors weigh from 20 to 40 per cent less than cast iron frame fan motors of corresponding sizes and are therefore much more easily handled and less expensive to transport. Moreover, this construction makes these fan motors remarkably handsome in appearance. The steel is drawn into graceful, harmonious lines, its surface is smooth and gives a lustrous finish, and the steel lends itself to a variety of beautiful metal finishes. The standard finishes are black enamel and black oxide, similar to gun metal.



Drawn Steel Desk and Bracket Fan.



Air-Operated Oscillating Fan.



Mechanically-Operated Oscillating Fan

Another special feature of these fan motors is the swivel-and-hinge joint which connects the motor and the base. By means of this joint, the fan can be tilted within 105 degrees or rotated within 340 degrees in any direction and can be changed from desk to bracket mounting without the use of a trunnion, tools, or an adapter. All that is necessary to make any of these adjustments is to loosen a wing-nut; when the wing-nut is tightened the fan is locked in position and can be neither tilted nor rotated.

All 25-30, 50 and 60 cycle fan motors have three speeds and there is a marked difference in the effect of the fan at each speed. The speeds are controlled by a lever in the base of the fan which is firmly held at each running point and does not open the circuit between points. The fans will start and can be operated continuously on any point.

A new line of mechanically-operated oscillating fan motors in drawn steel frames, a further development of the desk and bracket line, will be offered this season. In these fan motors the oscillating mechanism is entirely enclosed; the oscillating movement can be stopped and started while the fan is in motion; the fan can be tilted or changed from desk to bracket mounting without the use of a trunnion or an adapter; and if the fan guard strikes an obstruction during the course of oscillation, the fan merely stops oscillating without interfering with the operation of the motor so that the overturning of the fan or the burning out of the motor is prevented. The wearing parts are readily renewable without using tools. The range of oscillation can be adjusted and the mechanism is packed in lubricant.

Mechanically-operated oscillating fan motors in cast iron frames of the design so successful last season, are again offered. The gears of the oscillating mechanism operate in a closed case packed with grease and require lubrication once a season only. The arc of oscillation can be made 45 degrees or 90 degrees, or the oscillating movement can be stopped altogether if desired.

The air-operated oscillating fan motors offered this year are an improvement over last year's models. The oscillating movement is effected by means of vanes mounted in front of the fan guard; the arc of oscillation can be varied from 30 degrees to 360 degrees, in steps of 30 degrees. The current is carried from the base to the motor through slip rings so that there are no leads to be broken.

A MODERN ELECTRIC SUPPLY HOUSE.

The Pacific States Electric Company of San Francisco, Oakland, Los Angeles and Portland have recently so perfected their sales organization that they are now prepared to fill all orders with the greatest dispatch from their four supply houses. These stocks are among the largest and most complete carried on the Pacific Coast and in them the central station and the contractor will find all kinds of electrical apparatus and supplies ready for immediate shipment.

This company takes particular pride not only in its thoroughly trained selling force but also in the excellent system whereby it handles all orders as received. Thereby they are enabled to give the customer that service which is so essential to satisfaction.

The catalogue and price list of the Pacific States Electric Company is the most comprehensive ever compiled by a Western firm and is invaluable to every electrical man who desires to know "where he can find it in stock on the Coast." The company is anxious to furnish all those not owning a copy of this "encyclopedia electrical" with both the catalogue and the price list, which contains several novel features facilitating its use.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—Continuous Concrete Pipe Company; incorporators, J. B. Carr, George R. Norton, L. W. Bentz; capital stock, $250,000.

RIVERSIDE, CAL.—The Inter-State Telegraph Company has incorporated with capital stock of $500,000. The directors are: P. E. Ellis, James Smythe and William Muller. The company will operate telephone and telegraph lines.

LIBBY, MONT.—J. H. Ehlers, Spokane, has formed the Yahk Power Company to harness Yahk Falls and develop power, which will be sent to Libby and other points. Milwaukee capital is said to be interested with Mr. Ehlers.

SEASIDE, ORE.—The Mutual Telephone Company has been organized by W. D. Torrey, Audley Gregg and Chas. Williams, who received a franchise from the county court to construct a line to the mouth of the Elk Creek River, a distance of nine miles.

SAN BERNARDINO, CAL. The Stowe Water Company of Redlands has incorporated with capital stock of $10,000, of which $500 has been subscribed by Elizabeth J. Stowe, E. A, Stowe, L. F. Churchill, J. M. Woehr, all of Redlands, and C. F. Bailey of Los Angeles.

ORIENT, WASH.—A telephone company will be incorporated here to be known as the Columbia & Kettle River Telephone Company, which will connect the towns of Rossburg, Boyds, Napoleon and Orient. Fred Shriner, Geo. Lane and W. R. Ward are the directors.

SACRAMENTO, CAL.—The Midland Counties Gas & Electric Company has been incorporated for $1,000,000, by W. G. Crittenden of Berkeley, W. A. Nunlist, J. J. Webb and P. W. D. Webb of San Francisco and J. A. Williams of Alameda. The place of business is San Francisco.

STOCKTON, CAL.—The Tidewater & Southern Transit Company has filed articles of incorporation for the purpose of constructing 172 miles of railroad extending from Turlock to Fresno, and touching with branch lines various points in San Joaquin, Stanislaus, Merced and Fresno counties. Of the total amount the sum of $189,200 has been subscribed. Stockton is the principal place of business of the incorporation and the following are the stockholders: Karl C. Brueck, J. A. Coley, Byron A. Bearce, J. L. Craig, George S. Schuler, Ward B. Minturе and T. J. Wisecarver, all of Stockton.

ILLUMINATION.

ALAMEDA, CAL.—The calling of a bond election to raise $125,000 for improving the municipal electric light plant will be considered soon by the City Council.

GLENDALE, CAL.—Lights in West Glendale, for which $40,000 bonds were voted February 2, will be installed as soon as the bonds can be issued and sold.

COLTON, CAL.—The F. O Lantz Electric Company has been awarded the contract for furnishing the city with electrical supplies with which to install the proposed new system.

LAS VEGAS, NEV.—Kennard Moore has taken the contract to build the new buildings to house the gas and electric plant of Consolidated Light & Power Company, south of town.

TACOMA, WASH.—Commissioner H. F. Gronen reports that the city lighting plant distributing system will be rewired this year to care for the current generated by the new Nisqually municipal project.

TRUCKEE, CAL.—It is stated here that the Southern Pacific Company is preparing for the installation of an electric power plant on the Truckee River for the purpose of furnishing electricity for its yards, shops and buildings here. The dam at the Truckee electric plant went out some time ago and has not been repaired, and as a consequence the lighting service has been poor, there being insufficient power to serve the amount of light that is needed.

TRANSPORTATION.

RONAN, MONT.—The Flathead Power & Traction Company has been surveying for a line from Dixon to Polson.

OLYMPIA, WASH.—The right-of-way between here and Centralia for an electric line by the Washington-Oregon Corporation is being looked up. The road is assured.

MESA, ARIZ.—The Salt River Valley Electric Railway Company has been granted a franchise to operate for a period of 25 years a street railway along certain public streets and highways of the city.

NORTH YAKIMA, WASH.—To connect North Yakima with the Selah and Wenas valleys, construction of an eight-mile extension of the line of the Yakima Valley Transportation Company will be started.

NEW WESTMINSTER, B. C.—The Saanich extension of the British Columbia Electric Railway will have its terminus at Deep Cove. A branch line will be built to Union bay. Wharves will be built by the company at both points.

SALEM, ORE.—A traction road will be built from a point on the Corvallis & Eastern near Mehama or Lyons, to the mines of the Electric Mining & Smelting Company in the Gold Creek district of the Santiam region. Distance, 25 miles.

RAYMOND, WASH.—Sanderson & Porter, New York, who built the street railway between here and South Bend, have taken over the interests of the South Bend-Raymond Electric Company, for $100,000. Improvements to the system will be made.

SAN FRANCISCO, CAL.—The United Railroads is working upon a compromise of Supervisor Bancroft's ordinance to compel the company to operate its Sutter street cars by trolley down the center tracks on Market street to provide for some adequate service.

FRESNO, CAL.—The Stone & Webster Construction Company has established seven camps along the proposed line of the railroad from Gordon Switch, east of Clovis, to Pinnell's station, on the road to Big Creek and work is being rushed with all possible speed.

SAN DIEGO, CAL.—Negotiations are about to be closed whereby New York and Los Angeles capital will build the San Diego, El Cajon and Escondido electric line. Construction will be under way in less than 30 days. George W. Purcell is president and manager of the company.

LOS ANGELES, CAL.—The largest mortgage ever filed in the office of the county recorder is for $100,000,000 and was given by the Pacific Electric Railway Company to the United States Mortgage and Trust Company, a New York corporation, to secure an issue of 50-year gold mortgage bonds, to be issued by the railway company to provide funds for the extensive improvements and the new lines now being planned. All of the real and personal property of the corporation of every description is included in the mortgage—rolling stock, tracks, equipment of all kinds, franchises, rights of way, easements—everything. Of the $100,000,000 to be gotten from the sale of the bonds, $39,693,000 will be held as a fund out of which to redeem outstanding bonds of the various companies recently merged into the Pacific Electric as they mature.

WENATCHEE, WASH.—It is probable the city will give a franchise to the Felt interests for a street railway line here.

SOUTH VANCOUVER, B. C.—The British Columbia Electric Railway will be required to construct a car line between Fraser street and Victoria road.

MISSOULA, MONT.—Condemnation proceedings have been instituted to secure a right of way for an electric line to connect Missoula and Hamilton, a distance of fifty-six miles.

SANTA BARBARA, CAL.—A plan for the complete construction of the Santa Barbara Consolidated street railway system has developed, and at the next meeting of the City Council a proposition for a solution of the problem will be made by Geo. A. Batchelder of Menlo Park, former coast representative of E. R. Rollins Sons, bankers, and Geo. I. Cochran, president of the Pacific Mutual Life Insurance Company. The plan is to ask the city for a 45-year franchise, giving the right of purchase after 35 years, a board of appraisers to set the price. The company also will agree to turn over to the city 2 per cent of its gross receipts. If the council agrees, the company will immediately issue $500,000 in bonds, one-half for immediate needs, and the remainder to be used for future improvements. The bond issue will be secured by a first mortgage on the property of the company and the Southern California Edison Company of Los Angeles will guarantee interest. The holdings of the present bondholders aggregate $163,000. The Southern California Edison Company will operate the road. The intention is to double-track State street and lay new rails on all lines, extending several of them. New rolling stock also will be provided.

TRANSMISSION.

RED BLUFF, CAL.—Red Bluff is talking of calling a bond election for the construction of a municipal water and electric lighting plant.

SPOKANE, WASH.—The International Power Company has filed claims on water power at three points on the Pend Oreille River, and expects to erect a dam and power plant at each.

POCATELLO, IDAHO.—A crew of men is getting ready for the installation of a hydroelectric power plant at Black Canyon, to develop power for the operation of a big flour mill which will be erected this year at Grace.

LIBBY, MONT.—J. H. Ehlers of Spokane states that he has completed all the financial arrangements for erecting a power house at Yahk Falls, 10 miles from where this river empties into the Kootenai. The power generated will be about 5000 h.p., of which 1000 h.p. is to be transmitted 18 miles to Libby for municipal lighting and industrial purposes.

REDDING, CAL.—The Northern California Power Company of this city, which recently purchased its only rival in the northern part of the State, the Sacramento Valley Power Company, will re-establish meters throughout its territory, which embraces Tehama, Shasta and Glenn counties, together with a good deal of Colusa and Butte counties. Flat rates will then be abolished.

SAN FRANCISCO, CAL.—For the first time in history, electric power at 11,000 volts has been transmitted across San Francisco Bay. The Great Western Power Company, which recently laid a heavily armored cable 20,000 feet in length and 3¾ inches in diameter from the Western Pacific Mole in Oakland to the foot of Howard street, San Francisco successfully transmitted power last week. Power can now be sent across the bay from the City Electric steam plant in San Francisco in case of any interruption to the hydroelectric service from the Big Bend plant of the Great Western Power Company.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—The McCarthy Wireless Telephone Company has made application for dissolution.

CRESWELL, ORE.—Geo. M. Hawley and Schmitt Bros. have asked for a telephone franchise in this town.

SPOKANE, WASH.—A 20-year franchise has been granted to the Farmers' Inland Co-operative Telephone Company.

EMMETT, IDAHO.—The business men here will immediately organize an independent telephone company to take care of local business.

BOISE, IDAHO.—The ordinance compelling telephone and electric light wires to be placed under ground by January 1, 1913, was passed.

RED BLUFF, CAL.—The Independent Telephone Company is to build an extension to all parts of Tehama County and to have long distance phone from Redding to Sacramento and San Francisco in a short time.

LOS ANGELES, CAL.—For the purpose of transmitting school news from the University of Southern California to and from other educational institutions throughout the State, a wireless station will be built at the local school. It will have a span of 400 ft. and hang of 105 ft. from the ground. It will have a sending capacity of 400 miles and unlimited receiving scope. It will be ready for use in about a month.

WATERWORKS.

EUREKA, CAL.—A special election to vote on water bonds will be held March 11.

UNION, ORE.—Union is about to make $20,000 worth of improvements on its water system, and the question of whether to use wood or steel pipe is now under consideration.

OAKLAND, CAL.—A special meeting of the City Council will be called by Mayor Mott next week for the purpose of taking testimony preparatory to fixing the water rates for the fiscal year 1912-13.

CORNELIUS, ORE.—The town will soon vote on the proposition to bond itself for $27,000 to be used for installing a water system. Should the proposition carry a gravity system will be installed.

TUCSON, ARIZ.—The City Council is investigating the proposition for building an immense reservoir in Tucson Mountain at a cost of $100,000 with a capacity of 50,000 gallons of water. With such a reservoir pumps could be kept running at all hours.

SEATTLE, WASH.—The contract for the construction of a six-foot water main tunnel 50 feet below the surface of Twelfth Avenue South, has been awarded to George C. Deitrich & Co., at $26,636.20. A 42-in. steel Cedar River water main will be laid through this tunnel.

SALEM, ORE.—The City Council has appointed a committee to negotiate with the Salem Water Company regarding the purchase of the water plant operated by that company. Engineers are to make a thorough investigation of the plant preparatory to any final action in the matter.

HANFORD, CAL.—The Hanford Water Company will soon install another pump at its new addition to the main plant. This will be a duplicate of the 200 gallon turbine pump recently installed there. The company also contemplates removing their wooden tanks and replacing them with a steel tank.

SACRAMENTO, CAL.—A plan to furnish the city with mountain water, to be conveyed by means of a gigantic conduit from the summit of the Sierras, will be submitted to the Board of Trustees by James D. Stewart, manager of the United Water & Power Company of Gold Run, Placer County, to cost about $1,000,000.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, MARCH 2, 1911 | NUMBER 9

THE DEVELOPMENT OF THE TURBINE

BY GEORGE [illegible] HENRY, Jr.

Much might be written about the historical development of prime movers actuated by water, but it is not here intended to cover the historical field more than to crystalize the steps that bring us to the period of the last 75 years, since which the development has been most interesting and rapid.

From the earliest times of the Egyptians are found most ingenious devices for utilizing the kinetic energy of moving water to actuate mechanism of various kinds, to suit the purposes of what was then a highly organized civilization, a civilization, however, of mysticism and superstition and indeed priest-ridden to a degree found only among pagan nations. During a period of national development, when the channels of education, travel and communication were inaccessible to all but a chosen few, and so restricted in fact that a lifetime spent in the pursuit of knowledge resulted in a fund of general information that a seven-year-old school boy could today put to shame, so warped was this information from the real facts, as we know them today, that so-called common sense now puts to rout many of the convictions of the ancients, and even those of the medieval students and wise men of comparatively recent times.

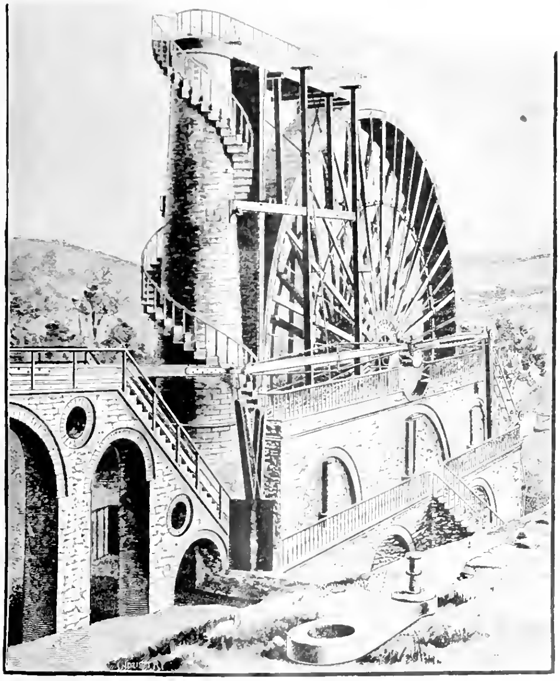


Fig. 6. Overshot Wheel, 72 ft. 6 in. Diam., 150 H.P.

And yet how real did the present at that time seem! How readily did Isis seem to speak from the animated statue actuated by a series of water buckets, cords, and levers, constructed by priestly cunning to give divine support to their temple teachings. How sacred was the river Nile and all its creatures—and justly may it have so been held—for was it not the father of all good in their land—was not the Egyptian civilization the direct result of this clustering of peoples around its beautiful banks, and indeed, to pursue the thought further, do we not find the rise and fall of Greece and even her legendary history, coincident with her exploits—from the fall of Troy and the quest of the Golden Fleece down to the birth of Rome? And Rome! Was not she the ancient mistress of the world, nurtured in her youth, maturity and age by "Father Tiber?" And were not the prosperous cities of medieval Europe dependent on their resources of water transportation? Did not Venice Queen of the Adriatic, rise to a position pre-eminent among the nations through her favorable maratime location? Spain and latterly England in more recent

times, have joined the long vista of nations who owe the history of their national superiority to the facilities which water has bestowed upon thus favored mankind.

And so, as a direct contributor to the advancement of national supremacy and creation of our modern civilization, water is found to have been an agent of the greatest importance and service to man. But this may be considered as a digression as it has but little reference to its use as an agent for the development of kinetic energy in its physical sense, however important a potential factor it may have been.

Its employment as a means of developing useful power, probably dates back also to the dark ages, almost beyond the dawn of civilization. For water wheels are claimed by the Chinese 1000 B.C., although the period was one when human energy was by far the cheapest and the most universally employed agent, even less valuable than the work of oxen. Slave labor was ready at the bidding and in almost unlimited amount, to serve the whims and vanities as well as the conquests of ancient monarchs, as the ruins of Babylon, the Pyramids of Egypt, and the great Chinese Wall bear mute testimony. With this almost unlimited supply of human labor, what use had they for the power of falling water? Yet we find as mentioned above, the inventive genius of the priests making use of it in several very ingenious ways, such as animated statues and water clocks.

Some of the earliest uses of current wheels were to raise water for irrigation and stock watering, and many ancient canals and conduits show a general familiarity with its simple natural laws. But its general development lay dormant until such later time as man shirked his early bondage and harnessed for his needs and comforts, this God-given source of inexhaustible energy.

The first considerable uses to which water power was put were naturally those connected with agricultural pursuits, for agricultural lands were naturally situated along the banks of rivers or canals, and therefore what more natural than current wheels for such power as was useful for the husbandry of the day, and the raising of a little water to a little higher elevation to make a little more land productive. The question of efficiency, if considered at all, was most remote. An old current wheel would be rudely put together to turn the chain of buckets, and do the work for which the oxen or slaves had formerly been employed. This was not in the service of the monarch, or for that matter, any slave holder, but rather for the very poor man who had neither slaves nor oxen, and to whom necessity was veritably the mother and father of invention.

This current wheel then found its way to rapids and water falls, and we have the germ of the undershot wheel. As time runs on, and human labor began to have some value, we find the overshot type used some distance away from the stream, where power was wanted for grinding corn or other primitive work, the water being led to it through masonry conduits or flumes, thus giving a considerable power in a more useful location, and in many instances, confronting man with an amount of power almost beyond his needs, and in most cases, far more than any crude machine could then advantageously use. Subsequently, therefore, inventive effort was concentrated for centuries on the improvement and enlargement of machinery for the use of this "Frankenstein," before the question of efficiency became important.

Some early forms of wheels however came into quite extensive use. The old English Doomsday Book mentions several hundred then in use in England at the time of the Norman Conquest, almost all for grinding corn, and although these must have been very crude devices, they certainly served well the requirements of the time.

Great must have been the effect on mankind of this discovery of water power, secondary only to that of ships, and wagon wheels. So great a source of power, and so susceptible was it to give much more than his most extravagant needs required, that we find the question of efficiency again one of no moment.

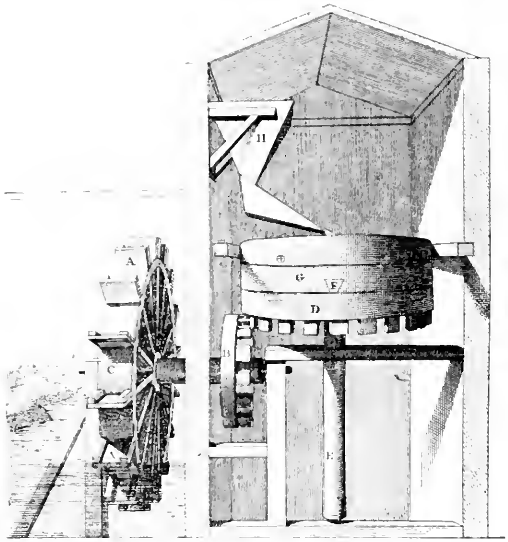


Fig. 1. Early Form of Current Wheel to Grind Corn. Vitruvius, Rome 14 B. C.

Probably one of the earliest recorded adaptations of the current wheel for industrial use, is that of Vitruvius and illustrated in Fig. 1, where the power developed is used to turn the mill stones, the grain being fed in from the hopper "H."

Showing distinctive lines of thought, may be contrasted the impact wheel in Fig. 2, also of very early but unknown origin, and not at all unlike the general arrangement of the jet and buckets of the modern steam or gas turbine.

The overshot wheel was well understood by the middle of the eighteenth century, some really scientific thought having been given to the various factors tending to get the most power for the least cost of construction. The names of Euler and of Borda are linked with particularly clear thought on the subject of eliminating the losses of impact and discharge velocity. Euler was a Swiss mathematician 1707-1783, Borda a French mathematician and astronomer 1733-1799. Euler studied the mathematics of the flow of water over curved surfaces and indicates forms of

guide and runner surfaces for improving efficiencies not unlike those found in wheels built at the present time, and which principles are in fact of fundamental value. See Fig. 3.

In the late eighteenth century we find some of the mills in France driven by wheels provided with spoon shaped buckets—the wheels being mounted on vertical shafts to fascilitate the connections with the mill stones and avoid the troublesome gearing (Fig 4). These show quite clearly the result of Euler's teachings and an understanding of the necessity of eliminating any shock or disturbance to the entering water and the effort to minimize the velocity of discharge.

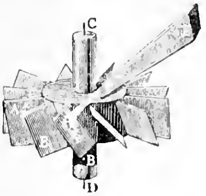


Fig. 2. Early Form of Impact Wheel.

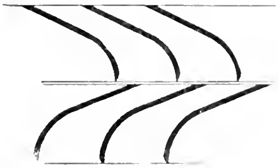


Fig. 3. Shapes of Guide and Runner Vanes to Avoid Entry Losses. (Euler, 1754.)

The wheel shown in Fig. 5 in which the water enters the curved blades substantially tangential and leaves after giving up most of its energy (if the wheel velocity is properly proportioned to the velocity of the entering water) indicates a very clear understanding in the early part of the nineteenth century of the value of proper bucket or vane curvature and is a more careful elaboration of the principles embodied in the wheel of Fig. 4.

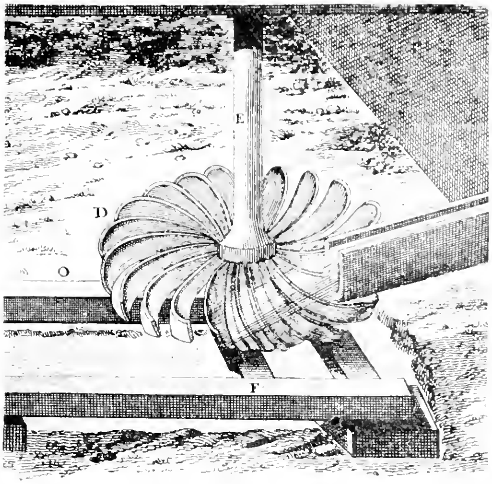


Fig. 4. Impulse Wheel Fitted With Spoon-Shaped Buckets (Mills in France, late Eighteenth Century.)

This type of wheel, Fig. 5, with its especially ingenius gate mechanism, received real commercial adaptation, and gives us one of the earliest indications of the modern turbine. It is the natural result of a demand for more power and the multiplying of the number of nozzles until water entered around the entire circumference, the water thus having a whirlpool appearance. The "whirl-pool" action in a turbine was thus derived synthetically and not analytically from observation of whirl-pools in rivers.

It is quite natural that as the demand for power in larger units grew more acute, we should find a tendency to generate more from the then known wheels, and what more natural than that of increasing the water issuing against the runner blades by utilizing the entire periphery of the wheel to receive its impulsive action. And so the art progresses to the generic forms of that class of water wheel most generally spoken of today as "turbines"—this being that class which employs pressure or pressure and impulse around most or all of the circumference of the runner as distinguished from overshot, undershot, impulse and tangential wheels.

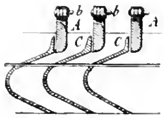


Fig. 5. Curved Bucket Impulse Turbine With Slide Gates. (Early Nineteenth Century.)

A good example of the overshot is shown in Fig. 6, showing one of these wheels in use for many years at the tin mines on the Isle of Man.

In this case the wheel is 72 ft. 6 in. in diameter, which is of course the working head or pressure it employed and developed 150 h.p. at a painfully slow speed. The masonry conduit employed to bring the water many miles combined with the cost of the wheel made the first cost per unit of power developed something enormous.

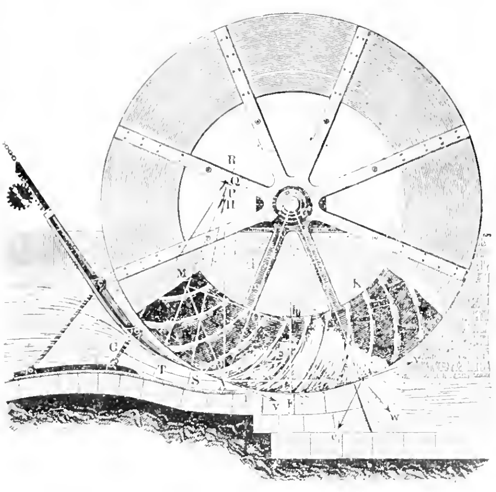


Fig. 7. Poncelet Undershot Wheel (Weisbach-DuBois.)

The writer saw a 50 ft. diameter overshot wheel in Mexico in 1896 on which it was said the freight from Vera Cruz (before the railroad was put in) amounted to over $100,000, which wheel was shortly afterward replaced by the introduction of electric

power, needless to say at a great saving in operating cost as the water then became available under a higher head.

The undershot wheel was brought to a very successful design by Poncelet. See Fig. 7.

Here it will be seen that the water energy is largely converted into velocity and received on curved surfaces where after its velocity is given up to the blades of the wheel it discharges by the action of gravity—the efficiency over earlier current wheels was increased quite 50 per cent by this method and quite an efficient gate or controlling device was employed.

The name "turbine" seems to have first been applied in France to any water motor or wheel when revolved in a horizontal plane and on a vertical axis (their first considerable use having been for driving mill stones). The first one really scientifically built was that of Fourneyron who received a prize from the Societe d'Encouragmente for his improvements. The

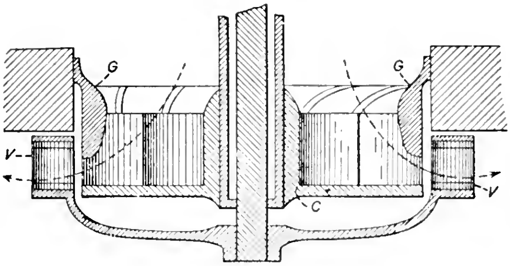


Fig. 8 Cross Section of Fourneyron Turbine (Morin)

word "turbine" has come however to have a much more restricted meaning on account of the tangential or impulse wheel now being differentiated from pressure and pressure and reaction wheels.

Impulse or action turbines are those in which the entire kinetic energy in the water at the time it enters the runner is expressed in terms of velocity, whereas pressure or reaction turbines are those where the potential energy is not entirely converted into velocity before entry. It will be noticed that in the former the water passages need not be filled with the flowing water and in the latter case they must be so filled to avoid losses. In the former case partial admission is usual, in the latter, complete annular admission is always found.

No truer example is to be found in the history of invention, of its following in the wake of necessity, than the development of the turbine.

The Fourneyron turbine mentioned above attained quite extended use following its introduction in 1827. It is of the outward flow type, and is illustrated in Figs. 8 and 9.

The runner is mounted on a vertical shaft and carries a series of curved blades or buckets. Water enters through the fixed curve passages of the guide chamber "C" and through a continuation of these guides in the gate ring "G." The rotation of the gate ring admits more or less pressure water to the runner, thus providing regulation. Carefully designed wheels of this type are said to have given 80 per cent efficiency and it was well adapted to very much higher heads than had been formerly used. This outward flow Fourneyron turbine has been used until quite recently and probably its best known installation is at the No. 1 Plant of the Niagara Falls Power Company, see Fig. 10, where very satisfactory results were obtained. This plant was one of the pioneers in hydroelectric development and will receive further consideration later.

Coincident with the growth of commerce and therefore of factories, and machines for the production

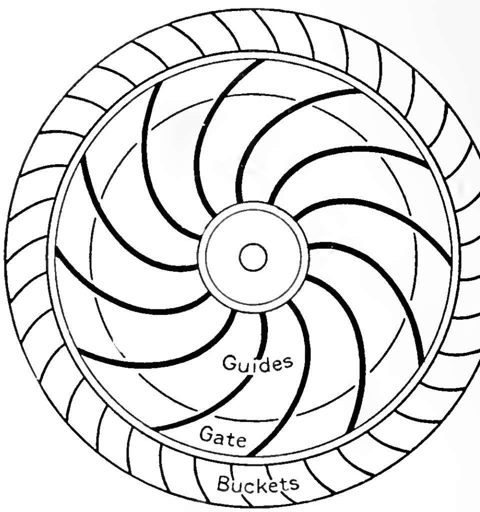


Fig. 9 Plan of Fourneyron Turbine Showing Guides, Gate and Buckets.

of fabricated products came the demand for power in larger quantities, and its value as a commodity. So factories grew at the points where water power was found available, and as the capital investments became heavier, and the product greater, the improvement in overshot and undershot wheels kept even pace with the demand for power in increasing quantities. Following this recurrence to the old forms of undershot wheels as improved by Poncelot, we find crude forms of turbines, first of the pressure and then the impulse type, and with them the adoption of higher speeds in driven machinery and the abandonment to a considerable degree, of the cumbersome and inefficient reduction gearing. Thus was the trail well blazed for the discovery and rapid development of the steam engine, finding as it did, a great field, with then practically no question of fuel values to handicap its adoption, and giving wonderful facility to factory location which might then be chosen with much greater freedom and with consideration of such other factors as market location, transportation facilities and such questions of great economic importance.

The development, however, of some water powers of favorable location still offered inducements of great value, and we find some of the towns of Massachusetts growing up to the limits of the power available in their mill streams, and with business increasing and no more power in sight, or at least, not without great additional development expense. In this dilemma, J.

B. Francis, in 1847, attacked the problem in truly scientific manner, making a careful analytical study of the entire question with but little of a reliable nature in the way of data or literature, and his Lowell hydraulic experiments are indeed now of a classic nature.

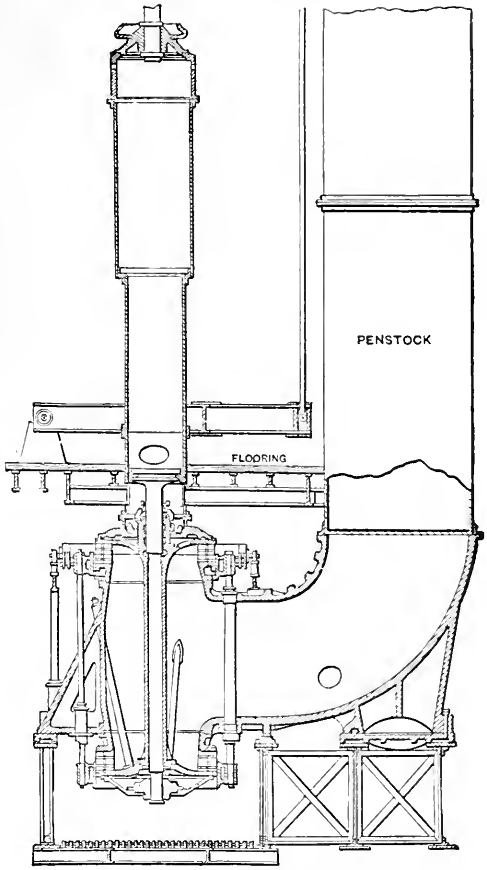


Fig. 10. Double Fourneyron Wheel, two runners being of greater and less diameter, water entering from underneath and above to secure hydraulic counterbalance for the weight of the revolving element. Each of the runners is divided into three sets of blades, thus making in reality six wheels on each shaft. Ten units of 5000 h.p. capacity under 136'-140' head are installed in the No. 1 power house of the Niagara Falls Power Co., New York.

The form of impulse and reaction wheel, today known to the world as the Francis turbine, and largely developed by him, still follows closely the results of his work. The United States had not then sufficiently grown as a manufacturing nation, nor was power so valuable as in some European countries whose scientists were quick to recognize its great value, and who, during several decades, have concentrated attention to the developing of this form of wheel, and its adaptation to commercial needs. The water powers of Switzerland, Northern Italy, Germany and Austria provided the drill ground for this recruit, and only within the last twenty years has the Francis turbine again come into its own in America. Indeed some of the earlier designers in this country avoided with unpardonable regularity, any profit of the really scientific work that had been done abroad, with the natural result that the banks of some streams are strewn with flotsam and jetsam of unnecessarily and often foolishly repeated experiments. This condition of things has also worked a hardship on the investor who now scrutinizes with cautious eye, the proposal to use turbine wheels for developing his water powers.

Without doubt, however, the finest turbines in the world, equal in efficiency to the best ever produced in Europe, and of the simplest rigid and safest construction, are now being designed and built in this country, together with the highest type of governing apparatus.

(To be continued.)

OPPORTUNITIES IN CENTRAL STATION MANAGEMENT.

BY C. W. KOINER.

In the course of an address to the students at the Throop Polytechnic Institute, Mr. Koiner who is the manager of the Pasadena (Cal.) municipal light plant, offered a number of interesting suggestions, from which the following has been taken:

A central station is managed as is any corporation, the power being vested in a board of directors. However, it usually falls to the lot of the general manager to carry out the policies of the company, and to be responsible and to represent the corporation in its activities. Sometimes this power is vested in one officer holding the dual position of president and general manager. In a great many instances, where properties are owned and controlled by banking institutions and syndicates, the officer in active charge of the property is usually the general manager.

Some of the necessary characteristics of a central station manager are, first character (a man should be well grounded in the fundamental principles of honorable dealing), ability, patience, tact, industry, courage, perseverance, common sense and technical training. These characteristics are required for a small plant as well as the large one. The manager who is in charge of a small plant has to meet the people face to face and is often brought into direct contact with his customers, whereas in the large central stations the general manager rarely meets his customers, unless it be an extremely large user.

In most instances the manager of a utility company, light, power, gas, railway, etc., usually is in charge of a monopoly. To manage a property of this character in a state in which there is no regulation by commission, is not a small task. The central station manager is supposed to represent his company in a creditable manner in the community in which he serves. Necessarily he should be qualified to represent and carry out the policy of his company in a way that will be satisfactory to his patrons as well as to his company.

In this connection, I do not believe any man should accept the management of a property unless he has absolute respect for the policy of the company. If the policy is such that he cannot carry it out without being ashamed of it, or being placed in a compromising position, he should not attempt the task. There

are a great many times when we will not agree entirely with the policy of a company; that is to say, we may have an opinion that a policy inaugurated or established could be so amended as to improve conditions, when the policy may be an honorable one, and may only be a matter of business. The only policy worth considering in handling and managing a central station properly, is to do business on business lines, free from all political entanglements, giving high class service at a reasonable price, returning to capital its just share in the enterprise, and giving to the customer a little bit more than he pays for, if need be, and at a rate that will always enable the company to discharge its just obligations to the community it serves and also to its employees.

I am in favor of a high standard for both salaries and wages, as well as a high standard of performance. It has been said that low wages, and I might add irregular employment, is responsible for more misery and poverty in this world than any other one thing, and I believe it.

The central station manager is facing the problem of how to sell more electrical energy along his lines. A very important department has been added in the conduct of the central station business, and is known as the "New Business Department." Just how much electrical energy can be used in a community, in other words the point of saturation, is unknown. With the lowering of the cost of electrical energy to the consuming public, the amount used is increasing at a rapid rate. As a general thing a household has a certain amount of money that will be spent for a particular service; a certain amount will be spent for electrical energy. With the lowering of rates for lights in the various communities, the household will immediately adopt electrical energy for other purposes. Heating devices, vacuum cleaners, small motors and the like, are attracting the attention and are being adopted by a large proportion of central station customers.

In some of our old eastern communities the number of houses using electrical energy varies from 30 to 50 per cent, depending upon the progressiveness of the companies serving the communities, while on the Pacific Coast the proportion (especially in Southern California) is at least 95 per cent of the houses along the lines. However, the companies in the East have been inaugurating the New Business Department, putting managers at the head of this department, who are in charge of all the solicitors and the campaign for securing new business. These campaigns have had a marked success, and it is remarkable to what extent the service can be extended, even in small communities. In fact some of the very best showings have been made in the small towns. One town in the State of Ohio, I think, had the record last year. Their annual income per capita was between $8 and $9. This was in a town of about 5000 population.

Therefore, you can readily understand that the opportunity for increasing the efficiency, for extending the business and for making improvements, setting a high standard of operation, etc., does not belong exclusively to the larger central stations. It frequently happens that some of the managers in the smaller companies set very high standards, and the larger companies, a great many times, learn valuable lessons even from the small central station manager. It is a good thing for a young and ambitious manager to remember one thing, and that is—that a man who can operate a small central station successfully can always get a larger one to manage.

A great many central stations are now owned by syndicates, and the policy of management is directed from the parent office. I regret exceedingly that this is so. In some instances it is of course a great improvement over the old method, where local owners did not really understand the central station business, nor would they employ a manager who did understand the business. Of course it is a great improvement to have these stations operated by the parent office, which understands the management and operation of such properties. However, on the other hand a plant that is not owned and controlled by a syndicate can be operated by a high class manager at less expense and in a more efficient manner than is the case with a great many syndicate owned properties. The reason is, with the syndicate owned property the overhead expenses overbalance the gain that would reasonably be expected by consolidating a number of properties and operating them by one head.

Some of the reasons for the high overhead cost are that the promotors, those who are engaged in making a big hit in selling securities, usually organize an operating company, whose officers have to be compensated by large profits, together with the usual construction company organized for taking more profit; and the purchasing, of course, is done for all of the properties and sometimes an additional charge is made on the purchasing and charges made to the constituent companies. In one case with which I am familiar, some of the local companies did not remit their earnings over and above their operating expenses, and interest on investment, that is the surplus which was used as working capital, and the parent company charged their constituent companies interest on the unremitted balance. Of course, under State regulation this would not be approved, because the primary reason for so doing was to make the cost of operation look higher to the local community that the company served.

I am of the opinion that companies can grow too large for efficient management. I believe that where a company does not have a monopoly, it could not stand the competition of a well managed competitor. I am speaking now of the extremely large corporations, and especially of properties owned and controlled by holding companies. It would be an easy matter to go into any city of 25,000 population or more, and install a competing plant, under local management, that would be first-class and give a rate that would be lower than any syndicate owned property could possibly give, and pay interest on the investment charged against the plant, and pay its other overhead charges. After analyzing the difference between the plant controlled and operated by the syndicate, and the plant owned and operated by local management, I find that the results obtained by local management, when in the hands of good managers, excel the results obtained by other methods of management.

The American public is prone to fall down and make obeisance to large aggregations, or seemingly

large aggregations of capital. In other words, when we mention a large concern the public gives up before they consider, and feel that they would not be able to compete. I am of the opinion that the larger the corporation, unless they are given a monopoly, the easier the competition. This remark does not necessarily apply to all central stations or to electric stations of large capacity, neither is the remark confined to central stations only.

An ex-manager of one of the largest firms of this country, recently remarked that no corporation could compete with the individually managed property, or co-partnership company, when all of the real owners were on the job.

The young engineer, and the young man who is preparing himself for a responsible position on the managerial staff, whether it be of central stations or industrial enterprise, must not take too much for granted, but must satisfy himself of the truth of the conditions and the fundamental principles involved in his line of work. It will be found that the place offering the greatest opportunity for improvement will be with the large corporation, which includes municipalities, and public works of State and Nation. That is to say, the efficiency can be considerably increased, and as the independent companies spring up, whether central stations or industrial, the large companies will be in search of young men and engineers who can point out the weak places and increase the efficiency, for which they will be willing to pay handsome salaries to those who can get results.

The electric central stations absorb ten thousand men every year.

It is not a very hard problem to manage a very large concern that has a monopoly of the business it conducts. There can be great waste without detection. However, when this concern is brought into competition with a rival that operates its property in an efficient manner, cutting out the waste, and bringing up the efficiency, then it is that such a company's mismanagement will show.

A great many concerns invite competition by maintaining a rate that is entirely too high. This warning was given by Mr. Edison in the early days, in fact at the time he formed the first central station, by calling attention to the fact that when the rates were too high it invited competition at once.

Hence the future offers great rewards to the young man who is properly trained, and one who is vitally interested in the work and who will specialize and take the branch for which he is suited.

Referring to the old adage "There is always room at the top," this, of course, has always been true and is true today more than at any other time in the history of the world. Mr. Edison claims there are more ten thousand dollar positions than there are ten thousand dollar men to fill them.

There is a good opportunity for those who will take the time and pains to learn the central station business. Even if we cannot attain to some of the highest positions in some of the largest companies, municipalities, States or Nation, it may be possible for us to take the highest position in some of the smaller companies, or it may be possible for us to hold some responsible position in some of the larger companies.

As you court responsibility, so your position will be a higher and better one. The high salaries require responsibility. Central stations today need men who know the business and who are willing to give the necessary time to learn the business from the smallest detail up to that of the largest duty in connection with the business.

I do not believe the work of learning the business, or any business for that matter, is as hard on the young man, as the worry that he will encounter if he does not learn the business, when he gets into a responsible position. Work does not hurt us but worry does.

The habits formed in the early part of our career are sure to stick to us. And in this connection, we should be very careful not to hinder our progress by acquiring habits that will be a detriment after we progress to the point where we expect promotion, we should be prepared for it.

That which will benefit young men most today is the practice of the homely virtues. These are overlooked by a great many young men who spend four years or more in college, and when they seek employment put in jeopardy their prospects by bad manners at the time they are applying for a position. They will walk into the office of a prospective employer with a cigarette or cigar in their mouth and their hat on their head, and with an attitude that would give one the impression that the business could not exist unless they were engaged immediately.

This characteristic applies to a great many young sales engineers. It militates against their progress. Some do not realize that it does, but if they were in possession of the true facts they would realize that it did hinder their progress.

There is a time and place for all things, and the time for a young man to put forth his best efforts is when he is endeavoring to make an impression seeking advancement and seeking to sell what he has acquired by four or five years of hard study, to the concern that will pay him for the exercise or use of his brains.

A UNIQUE FINE SYSTEM.

A source of saving to the city of Walla Walla, Wash., little known to the general public is the fine or refund charged the electric light company for every light found out at night during the year, which during 1911 netted the city in the neighborhood of $150, by a rough estimate. This amount is credited to the city by the Pacific Power & Light Company in collecting its regular light bill. The system by which this sum is obtained is that whenever a patrolman finds a light off when it should be burning he notifies police headquarters, where a small record book is kept. About 400 lights were reported out during the past year, and for each one of these the city receives $33\frac{1}{3}$ cents, so that the police department more than pays for the small amount of work necessary to keep the record.

The most northerly wire on the American continent is the newly completed telegraph line which the Canadian Government has constructed to Dunvegan, Alberta, on the Peace River extension.

SMALL ELECTRIC PUMPING PLANTS.

Owing to climatic conditions, an artificial means of applying water to growing crops is essential to the highest agricultural development in practically every section of the West. Under careful application, irrigation has thus brought forth results on western lands unsurpassed in the world. The Pacific Gas & Electric Company supplying power largely to the great interior valleys of central California, has collected much valuable data on small electric pumping installations. Such information is of much value to all those interested in supplying power to agricultural districts.

Irrigation by pumping with electricity offers more advantages than any other system of irrigation. It has been thoroughly tried and proven successful in every instance. In many districts where ditch water is available pumping plants are being installed because of the convenience and reliability of electric irrigation. Wherever electric power is available for pumping the general prosperity of the irrigators is high, and crop failures are unknown.

First cost for each acre put under irrigation is, on most land, cheaper than buying ditch rights. The plant can be located to deliver water at the most favorable point, thus reducing in many instances cost of checking and ditching. The expense of sinking wells is not great, while the pits and buildings required are simple in construction. The pumping and electrical equipment is of the simplest and most reliable. All material for a 5 in. plant should not cost more than $800. A plant of this size will, in most soils, irrigate 40 acres of alfalfa or orchard.

Cost of operation will compare favorably with any other method of pumping. No attendant is required. The water is delivered at the time it is wanted, avoiding long waits, as is sometimes necessary with ditch irrigation. The quantity of water can easily be regulated by the irrigator. The cost of power is not excessive and is accurately measured by meters that can be easily read by any one. In this way a careful check can be kept on the cost of water.

The type of pumping plant most generally installed is a centrifugal pump direct connected to an electric motor and set in a pit near the water level. Centrifugal pumps are built in two styles, vertical and horizontal, each meeting certain conditions. A good centrifugal pump will draw water as far as a plunger pump, or about 28 ft. However, it will operate with much less power when set near the water level. For this reason pits are usually dug with the floor at or near the level of the water in the well when the pump is not running. These pits may be lined with concrete or boarded with redwood. The pit is covered by a house, frequently built with a wood frame and with sides and roof of corrugated iron.

The base or bedplate of the pump and motor should be held firmly to the floor by bolts imbedded in the concrete or timber foundation. In digging the pit enough room should be allowed to permit easy access to every part of the pump and motor. A substantial stairway or ladder should lead down in the pit from the ground level. An electric light should be hung in the pit and low enough to light every part of the pump and motor. A beam, carried by studding in the house frame, should be over the pit. This should be strong enough, and carried by studding equally strong, that a pulley and rope may be used for lifting out pipe, valves or parts of the pump that may need inspection or repairs. To prime the pump a small pitcher or suction pump is usually connected to the top of the pump case or suction elbow. Its connection and method of operation depends on the use of a foot or check valve for keeping the pump full of water when not running.

An important feature in drilling a well is developing the water supply. When the perforated casing is landed in the water-bearing strata, or the casing punctured, whichever method is used, it is important that the largest reservoir possible be formed in the water zones. This is done by pumping out the sand and gravel around the pipe. If done carefully, a large saucer-shaped cavity, with the casing passing through its center, is formed. If not carefully done, the upper strata may cave and greatly reduce ,or entirely prevent, the water flow. Where a well has been properly developed it will make but little sand afterward, thus reducing wear on the pump and making sand pumping unnecessary. This work of devolepment is usually part of the well drilling contract. Insist that it be done properly and not slighted or hurried in an effort to get to the next job.

The pit should be large enough when finished to allow at least two feet between any of the machinery and the wall. At one side of the pump enough space should be allowed to remove either pump or motor from the base. In some ground the side walls of the pit will stand without bracing during the excavation. In such ground it is best to dig the pit large enough that the back forms used in pouring the concrete can be removed. When back filled and tamped a better-looking job will result. Where the ground will not stand, it is a good plan to place the bracing in such a manner that it serves for one side of the forms. When the pit is completed this side of the forms will be left in the ground.

All the cement manufacturers issue booklets describing different concrete mixtures and methods of pouring as well as form building. Use a mixture that will make a water-tight wall. To insure an absolute water-tight pit, a finishing coat should be put on. After the forms are removed, carefully clean the walls and floor. Then wet thoroughly and apply three coats, each one-eighth inch thick, consisting of one part cement, one-tenth part water slaked lime, and one part sand. In choosing your sand for concrete mixing, select clean, sharp sand, free from pebbles and surface soil. Be sure your cement is fresh and perfectly dry when you buy it. If it must be stored, put it in a dry, well-ventilated, room. Cement can be stored for an indefinite length of time in a dry place, but a small amount of moisture in the air will rapidly reduce its strength. If gravel is used for mixing concrete, better results will be obtained by screening into uniform sizes. Crushed rock is preferable for water-tight concrete walls.

Circular pits are rapidly coming into favor, as they allow better access to machinery and are more easily excavated and made water-tight. Where the well casing passes through the floor, a screen should be placed around the suction pipe to prevent any thing

from dropping in the well. Where cement or concrete construction is too expensive, redwood planking can be used for walling the pits.

The Electrical Equipment.

Where the wires enter the pump house, clay tubes should be set in the wall at an angle to keep the rain from entering. Outside a "drip kink" should be made. Just inside the building a switchboard should be set up. This may be a slate panel on a pipe frame, or a plank nailed to the wall for mounting the meters and other devices. Between these two extremes many different arrangements may be had. Convenience for reading the meters and controlling the pump are the principal things to consider when locating this board.

First in the electric circuit the fuses will be found. These are strips of metal buried in powder and enclosed in a fibre tube. A heavy or dangerous load on the motor will cause enough heat from the electric current to melt these strips of metal. The powder in which they are buried is a special compound that quickly kills the spark caused by breaking the electric circuit. The fuses are the safety valve, guarding your plant from danger.

Next in the electric circuit are the meters used for measuring the amount of power consumed. The meters are supplied by the power company.

The next device in the electric circuit is the switch for starting and stopping the motor. The best switch for this purpose is enclosed in an oil-filled tank. This is quite expensive, however, and most irrigators use what is known as a triple-pole single-throw knife switch.

Following the switch is the compensator or starting box. Throwing full voltage on the motor when it is standing still would cause damage. The compensator cuts down the voltage to a safe point until the motor is running at nearly full speed. The full voltage is then thrown on by moving the starting lever to the running position. The more improved types of compensators have included a device known as a no-voltage release. This serves to protect the motor from many electrical accidents and should always be used.

The wires from the compensator to the motor may be carried in pipes or conduit. This is the best method. In many plants, however, the wires are carried on insulators and brackets fastened to the walls of the pit. In putting these wires and devices in place, care must be taken that all joints and connections are well soldered, then wrapped with a pure rubber splicing gum and a second wrapping of insulating tape then applied. A good coat of insulating paint is the best finish. Failure to observe these precautions will result in serious losses of power and possible danger from life and to life. Be sure this work is done right.

In buying a motor, select some well-known make that is not an experiment. There are several well-known manufacturers that supply reliable motors, and it is advisable to buy from them. Motors are now rated rather close by the manufacturers. If twelve horsepower is needed for a pump, buy a fifteen horsepower motor instead of the ten horsepower machine some salesmen may contend is large enough. It is generally more satisfactory to have the local electrical contractor put in the electrical work than bring a contractor from the city, as any defects can be brought to his attention more strongly. Money spent in buying good electrical material and time spent in seeing that it is carefully put in place, will be amply repaid in lower cost for power.

Factors to Consider in Choosing Pumps.

A centrifugal pump consists of a rapidly revolving runner or wheel turning inside a casing. The water is led into the vanes, corresponding to the spokes, at the hub and is thrown outward by centrifugal force. This runner has no rim or tire and the water is thrown into the collection chamber cast in the casing, and surrounding the runner. From here it is carried in suitable piping to the point of use. It is self-evident that the faster the runner revolves, the greater the force with which the water leaves the pump. Likewise, the smoother the sides of the water passages and the fewer turns made in passing through the pump, the less power will be taken up by friction.

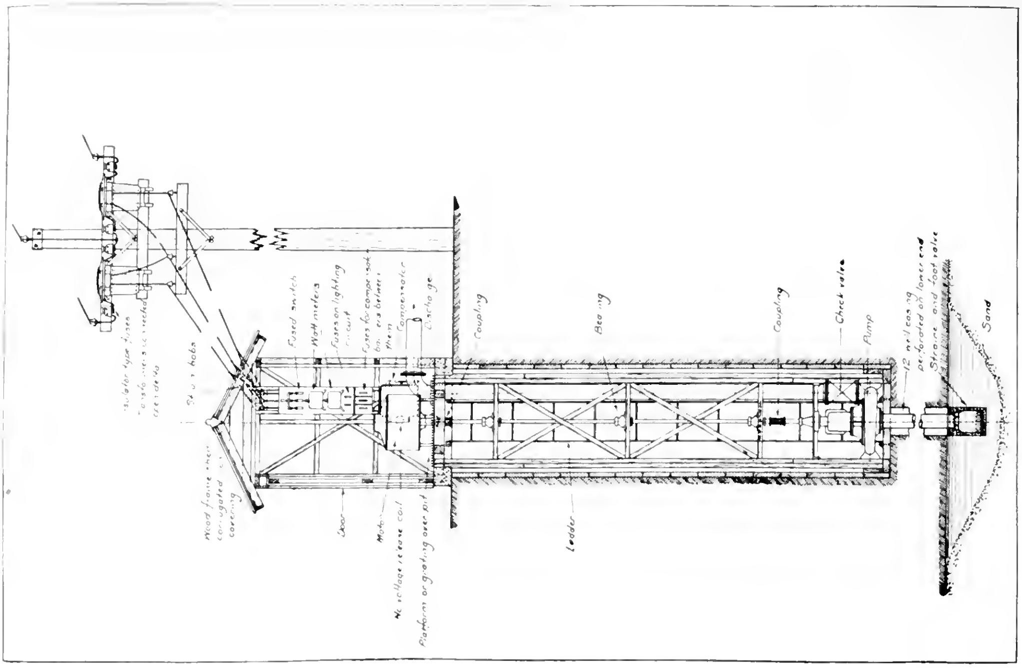
Proper sizes of runner and casing and correct shape of the vanes have everything to do with the efficiency, or amount of power required. The best way to be sure of getting an efficient pump is to buy of a reputable firm, which has had long experience in building pumping machinery. Their designers are, or should be, familiar with the proper relation of runner and casing that gives thhe best results.

Many salesmen put undue stress on the question of open runner and closed runner pumps. Both when properly designed and made are efficient machines. Their relative merits are comparable with the Percheron horses of one farmer and the Belgian horses of his neighbor.

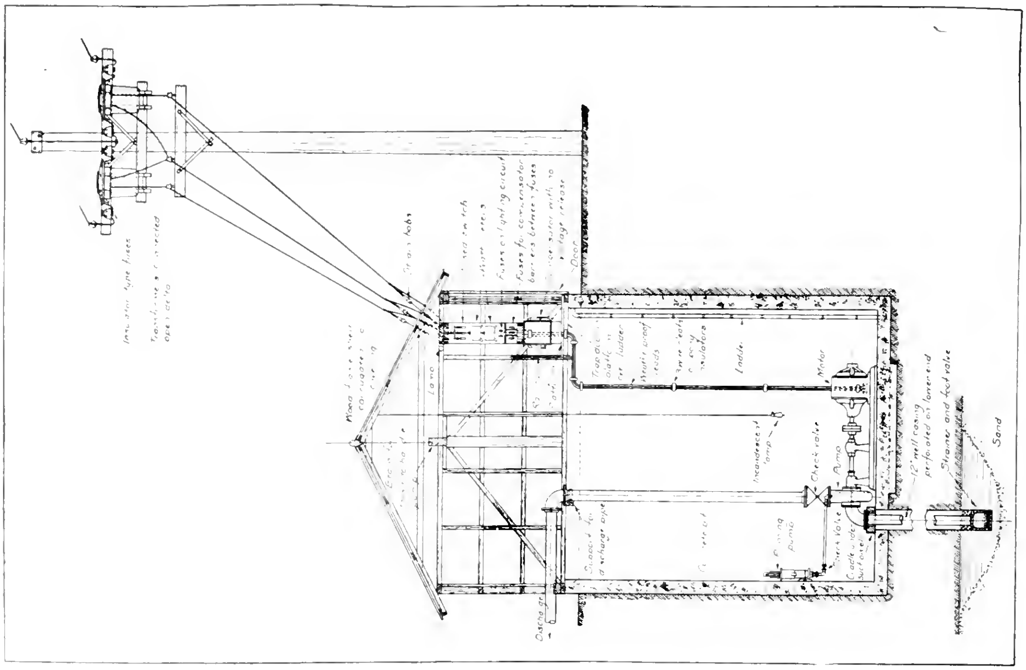
It is well to have an efficiency clause in the contract, and a final payment large enough to protect you if the pump does not come up to contract. After the pump is installed it is a good plan to have it tested by an independent engineer. This is not an expensive proceeding. The meter installed to determine your monthly bill accurately measures the power consumed, while the quantity of water pumped and total head are easily measured.

Avoid a pump with many complicated water passages. Be sure the shaft is strong enough to withstand the belt pull. Be sure it is in perfect mechanical balance. Do not accept a pump that vibrates when running at full speed. This is particularly imperative with a direct-connected pump. There is a strong tendency in the pump runner to pull to one side. This is called end thrust, and a pump that is designed to remove this thrust is said to be hydraulically balanced. Some pumps have special devices, operated by water pressure, for this purpose. Others have a collar on the shaft to absorb the thrust. Be sure that the pump you buy does not have a complicated device that is likely to get out of order, or a device that will be quickly cut out by sand. This is also true of the rings put on the sides of the runner to prevent leakage back to the suction side.

Wherever possible buy a direct-connected pump. The first cost is not materially greater when you consider the extra cost of belting, foundations, and belt way. Direct-connected pumps take less power to operate them, for at least fifteen per cent of the power is consumed in the belt. In many cases a new belt is required each year, no small item of expense. It is



Details of Vertical Pump Installation.



Details of Horizontal Pump Installation.

important that the manufacturer know the exact height the water is to be pumped before your order is placed, as direct-connected pumps are always made to order. This also means that a little longer time will be required for delivery. Buying from a reputable concern is even more important in this instance.

To sum the whole matter up, get a simple pump without any fancy automatic devices, with strong bearings and a shaft of ample size, and with its weight well distributed. And then buy from firms who are experienced pumping machinery builders.

Installation of Horizontal Pumps.

Many purchasers have the work of installing included in the contract price for the pump. In many instances money would be saved by the purchaser doing his own installation, with the aid of the local electrical contractor, as the manufacturer must protect himself against loss of time and fluctuations in the price of material. The manufacturers furnish a template, a wooden frame for suspending the foundation bolts. Before the cement floor is laid, set this template so that the foundation bolts will come in the proper place. To provide for slight errors it is a good plan to slip a short piece of pipe somewhat larger than the bolts, over them. When the concrete is poured the foundation bolts will be held in proper position to receive the pump base.

For lowering the pump into the pit, a gallows frame used for dressing beef will serve if the pump is not larger than five-inch. For larger pumps a stronger frame should be made. Be sure the ropes and tackle used are in good condition. When the pump is on its foundation, level it by thin wooden wedges and run a thin grout of one part cement, one part sand and enough water to make it pour, under the base. When this sets, draw the foundation bolt nuts up tight all around and the pump is ready for piping.

Use flanged piping on both suction and discharge. Be sure the pipe flanges that bolt to the pump flanges are properly drilled. The suction piping should always be standard piping, preferably galvanized. Power will be saved by using both suction and discharge pipes one size larger than the pump openings. Use flared fittings for connecting pipe and pump. The suction pipe must not be supported from the suction elbow. A cradle should be built over the well, and the flange on the end of the suction pipe may rest on this cradle.

Use a good quality of gasket in all flanges. A slight leak will greatly increase power consumption. To keep the pump full of water when shut down a short time, a check valve of some sort must be installed. If the total head pumped against is less than forty feet, a foot valve may be used. If the head is greater than forty feet a check valve must be put in the discharge pipe. Most foot valves have a strainer casing, but where a check valve is used a strainer should be put on the end of the suction pipe.

As a centrifugal pump will not throw water until the casing is full of water, or, in other words, will not prime itself, some means must be provided for doing this. A small hand pump is usually installed for this work. If a foot valve is used, priming may be done by pouring water down the discharge pipe. If a check valve is installed, a priming pump must be used. The proper place to connect a priming pump is at the highest part of the pump casing. One of the most common faults in starting a pump is becoming "air bound." Be sure every bit of air can be pumped out of the casing and suction pipe by the priming pump.

Double-riveted steel pipe, either galvanized or coated with asphaltum, is suitable for discharge pipe if the total head to point of discharge does not exceed eighty feet. Above this head, standard pipe will give better service. Always use flanged and bolted joints.

An elbow should be put on the discharge pipe and the pipe extended outside the building. Where the discharge enters the water box through the bottom, water is constantly splashing over and may cause burnouts in the motor. Do not discharge the water against the side of the ditch. Build the water box so that the water is guided into the ditch in the direction of flow.

Installation of Vertical Pumps.

Vertical pumps are usually installed where the ground water is so far below the surface that the expense of sinking a pit for a horizontal pump would be prohibitive. Instead of a pit, a shaft large enough to pass the pump is sunk and the pump installed at the bottom with the motor at the surface. A timber frame work is built in the bottom of the pit and a vertical frame extends from top to bottom, carrying pump and shafting. At the top a frame is built to carry pulley or vertical motor. Spreader bars should be spaced every ten feet on the vertical frame. Vertical bearings are attached to these for keeping the shaft in line. Great care must be taken that this shaft is kept in perfect alignment.

The frame work is usually put together on the surface; pump, shafting and bearings put in place and every part accurately fitted. It is then taken apart and lowered into the pit in sections. In the better grades of vertical pumps the stuffing boxes and bearings are inclosed so that submergence does not injure them. It is then possible to install the pump below water level, thus doing away with priming pumps. The weight of the suction pipe can be carried by the pump if attached to the bottom, but if it terminates in an elbow and is carried into the upper part of the pump, it must be supported separately.

The discharge pipe should be carried up one side or in a corner of the pit and not be attached to the pump frame at any point. If the total head exceeds forty feet a check valve must be used. For lower heads a foot valve is suitable. It is a good plan to use suction and discharge pipes one size larger than the pump openings. A flared reducing fitting should be used to keep friction losses low.

The ladder for reaching the bottom of the pit must be clear of the pump frame, yet so placed that all of the vertical bearings can be reached from it. No projecting set screws should be allowed on the shaft. It may become necessary to go to the bottom of the pit while the pump is running and a projecting set screw would be dangerous. If a belted pump is used, the cradle carrying the pulley must be well braced against the belt pull. Where a vertical motor is installed, the frame work supporting the motor must be rigid to prevent undue vibration. As a vertical pump requires considerable mechanical skill to install, it is best to employ a competent mechanic. Even with a highly effi-

cient pump, slight errors in aligning the shaft will result in serious losses of power.

Care must must be taken to keep the vertical bearings carefully oiled. Some manufacturers provide an elaborate system of oil pipes running to the surface. While handy, these are liable to become clogged or damaged. The best method is a good ladder from which every bearing can be reached.

Operating Hints.

Always use a good grade of oil in the bearings. This applies to both pump and motor. Poor oil causes excessive friction losses and frequently causes the soft metal bearing-lining to melt. Keep the cups full and when ring oiling bearings are furnished be sure the rings turn properly. Even a slight kink will keep these rings from turning so care must be exercised to keep them in condition. Keep the stuffing box packed with a good grade of packing. Do not experiment. The wear of revolving shafts is the most severe wear that can be imposed on packing. If you have a grade of packing that is giving satisfaction do not be lead off by the cheapness of another grade, for the material and workmanship entering into the manufacture of packing are expensive and few packings on the market are suitable for centrifugal pumps.

Many pumps are now being made with water sealed stuffing boxes; that is, with a chamber cast about the gland and kept full of water while pumping. This effectually prevents air entering the pump casing, but the seal must be carefully watched that the water is not drawn in.

Be careful to keep all joints in the suction pipe absolutely tight. The slightest leak rapidly increases the power consumption. Keep your well free from sand. If much sand shows when pumping it is advisable to shut down your irrigating plant and sand pump your well. Before the irrigation season opens you should test your well and sand pump it if necessary.

The above suggestions are general, as the pump manufacturers change their designs so frequently that instructions applying to a pump this season may not apply the next. Get complete instructions regarding special devices at the time you buy your pump.

Regarding the electrical equipment the only rules to follow are: to keep oil in the bearings and to keep the motor and switch dry and clean. Do not throw the switch from starting to running position too quickly. If these precautions are followed the electrical equipment will never get out of order.

Below is given a table showing the average capacities of centrifugal pumps. Some manufacturers increase the capacity of their pumps by using a larger size suction, others try to overrate their pumps by casting large suctions on a certain casing and calling the resulting pump the next size larger.

Size	Diam Discharge	Diam Suction	G. P. M.	Sec. Ft. and Acre Inch Per Hr.	H. P. Per Ft. Lift
1	1	1	25	.056	.02
1½	1½	1½	70	.156	.045
	2	2	120	.27	.06
	3	3	230	.518	.11
	4	4	420	.945	.21
5	5	5	700	1.57	.35
6	6	6	950	2.11	.44
7	7	7	1200	2.7	.55
8	8	8	1600	3.6	.75
10	10	10	3000	6.75	1.4
12	12	12	4000	9.00	1.8

TESTS ON INSULATOR PINS FROM CALIFORNIA EUCALYPTS.

A great deal of attention has recently been focused on the planting and growing of eucalypts in California. Many companies have been organized, much capital has been invested, and the large acreage already planted is being rapidly increased. The Forest Service has sought to aid eucalyptus growers by publishing such information concerning the tree and its uses as it could secure after careful study, and in circular 179 of the Forest Service may be found much valuable data.

The eucalyptus is a native of Australia and the adjacent islands, where some 150 varieties are found. It was introduced in California in 1856, when it was planted around San Francisco Bay for ornamental purposes. During the next few years it was planted in the Santa Clara Valley for wind-breaks. Since 1865 the eucalypts have been extensively planted in California, mainly for wind-break purposes around orchards and vineyards, and also for fuel. The extensive planting operations of the past four or five years have been taken up with the idea of furnishing not only fuel, but also telegraph poles, piling, and lumber large enough to make vehicle and carriage stock and furniture material.

About 75 species of eucalypts have been grown in California. The blue gum was the first species introduced into the State, and has been much more extensively planted than the others. Probably 90 per cent of the eucalyptus in California at the present time is blue gum. Of the many other species introduced, red gum, sugar gum, gray gum and manna gum make up by far the greater part. These five give indications of being well adapted to California conditions, although, of course, others may be found which will give just as satisfactory results.

As a rule, blue gum grows erect; it branches low in isolated specimens, but in close plantings the crowns are small and the lower trunks fairly clean. It reaches its greatest development along the coast and in river bottoms where foggy days are common and the annual rainfall is at least 15 inches. The species when grown under favorable conditions ranks among the fastest growing trees of the world. The wood is yellowish white and easily polished.

A combination of the results of the tests on green blue gum gives, in the bending tests, an average fiber stress at the elastic limit of 6907 pounds per square inch; an average modulus of rupture of 11,800 pounds per square inch; an average modulus of elasticity of 1,788,000 pounds per square inch; and an average elastic resilience (shock-resisting ability) of 1.58 inch-pounds per cubic inch. The average crushing strength parallel to grain is 4919 pounds per square inch; the average strength perpendicular to the grain at the elastic limit is 1329 pounds per square inch; and the average shearing strength 1625 pounds per square inch. In the air-dry material the strength is increased except in compression perpendicular to the grain.

In a series of tests on hickory, now under way

by the Forest Service, the average modulus of rupture of several kinds in a green condition, including pignut, shagbark, mockernut, big shellbark, nutmeg, and water hickory, runs from 9200 pounds per square inch for nutmeg hickory, which is considered an inferior variety, to 11,450 pounds per square inch for pignut. For comparison with these figures, blue gum has an average modulus of rupture for green material of 11,800 pounds per square inch, or slightly larger than for pignut hickory. The dry weight per cubic foot of blue gum is about 49 pounds. The average weight of oven-dry pignut hickory is about 51 pounds per cubic foot.

Let us next analyze the results of tests on the four eucalypts, red gum, sugar gum, gray gum and manna gum. Green sugar gum has strength values considerably above the other species. It has an average bending strength of 16,480 pounds per square inch and an average crushing strength of 7215 pounds per square inch. Red gum comes next in strength, with an average modulus of rupture of 12,570 pounds per square inch and an average crushing strength of 6047 pounds per square inch. Manna gum shows the lowest strength values of the four species. Gray gum occupies an intermediate position in regard to strength.

Enough has been done to indicate that some species of eucalypts grown in California may prove excellent substitutes for woods in use at present for cord wood, piling, posts, poles, cross-ties, mine timbers, paving blocks, insulator pins, furniture, finish, veneer, cooperage, vehicle stock, and tool handles.

The value of eucalyptus, particularly blue gum, for insulator pins, has been thoroughly demonstrated. Eucalyptus pins have been used extensively in California and have been shipped to Canada and the Eastern States. After fifteen years' service, sound pins are still in use.

In April, 1909, arrangements were made by the Forest Service with the Pacific Telephone & Telegraph Company to have eight eucalyptus globulus and eight tanbark oak cross-arms placed in the company's lines in San Francisco. They were originally 8-pin arms, but when set in the line only six pins were used, the two pin holes nearest the pole, upon either side, being left vacant. None of these arms were painted, although the standard arms were at that time protected in this way. The company does not now paint its standard arms. The arms were equipped with eucalyptus and tanbark oak pins, except in the case of one arm, in which standard pins were set. Both arms and pins were cut from planks which were air-seasoned at the Berkeley Laboratory for almost two years. The arms were manufactured at the laboratory and the pins at San Jose. The experimental material was set in the line on September 8, 1909.

The pins were inspected Nov. 7, 1911, and the following conclusions were drawn: The non-insulated tanbark oak pins were found in fair shape, but those of the non-insulated eucalyptus pins were in better condition. The insulated eucalyptus pins were found to be in excellent condition and in better shape than the others inspected, while the standard oak pins, both insulated and non-insulated, were in poor condition.

ENTROPY CHARTS AND THE STEAM TABLE.[1]

BY ROBERT SIBLEY.

Those who are accustomed to speak of indicated horsepower from the reciprocating engine at once wonder if it is possibe to obtain an indicator card from the turbine. Of course, a moment's thought will show that it is impossible to take an indicator card from a steam turbine because the fundamental operation of the mechanism is of such a nature as to preclude cards of this sort. It is possible, however, to draw an indicator card of the particular turbine in operation when we know the pressure, temperature and moisture relationship of the steam throughout its expansion.

In discussing the comparative rating of a reciprocating with a steam turbine unit, the comparison at once brings up a discussion of the particular standard to be used. The standards that seem to have become firmly imbedded in modern practice are cumbersome and, without careful thought and additional computation, indicate only approximate comparisons.

Thus, a reciprocating engine is said to require 21 pounds of steam per horsepower hour, while the particular steam turbine may require but 15 pounds of steam per kilowatt-hour and yet under certain extreme conditions the reciprocating engine may have better efficiency. The pressure, temperature and quality of the steam are important factors in computing the efficiency, for after all, it is not the actual amount of steam required per horsepower-hour or per kilowatt-hour, but rather the number of heat units necessitated in the operation of each unit of power. Speaking in general terms the following are given by Professor Ennis in his recent treatise on thermodynamics as the best results that have been obtained under ordinary working conditions.

SATURATED STEAM.

Type of Engine	Best Steam Rate. 1 HP.	Average Steam Rate. 1 HP.
Simple, Non-Condensing	21.5	38.0
Compound, Non-Condensing	19.11	23.0
Simple, Condensing	16.5	22.0
Compound, Condensing	11.22	18.0
Triple, Condensing	11.05	....
Quadruple, Condensing	(169 29 B.t.u.)	....
	B.HP	
Single Stage Velocity Turbine	15.17	....
Pressure Turbine	13.08	....
SUPERHEATED STEAM		
	I.HP.	
Compound, Condensing	8.99 (192 B.t.u.)	....
	B.HP	
Single Stage Velocity Turbine	13.94	....
Pressure Turbine	Approximately	
Multi-Stage Velocity Turbine	10	..

Since the above have no real meaning unless reduced to equal pressures and temperatures of admission and exhaust steam, it would then seem desirable to make actual heat unit computations in each particular case. When this is done, an absolute standard of comparison is obtained. Let us, then, see if we can construct the chart, which, by the way, is used in place of the indicator diagram in the operation of the steam turbine and is also becoming popular for reciprocating unit comparisons.

It will be recalled that in previous lectures we discussed at much length the usefulness of a quantity

[1]This paper comprises the Twenty-first Lecture of a series of articles appearing in these columns entitled "Primer of Applied Thermodynamics."

known as entropy. We did not dwell upon the physical meaning of this quantity but contented ourselves with explaining it as such a quantity when plotted as abscissas with ordinates as temperatures, the area enclosed represents the heat necessary to bring the gas to the state shown at any particular temperature and pressure.

In Fig. 1 let us suppose we have a pound of water, which is at 32 degrees F. Let us call the point B on this diagram a point of zero entropy and 32 degrees F. in temperature. By referring to Peabody's Steam Tables or those of Marks & Davis, let us now plot, to the right, entropy and temperature conditions for this water during the application of heat. The water will finally be heated to a temperature, let us say, of 373.1 degrees F. At this point, which is D on the diagram, let us suppose that the water is under a pressure of 180 pounds absolute. Hence the water is just on the point of vaporization.

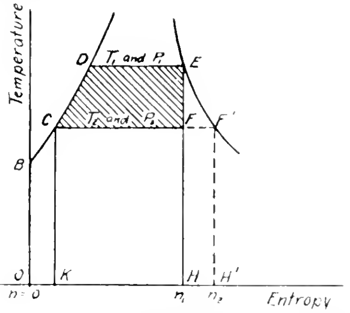


Fig. 1. Indicator Diagram for Turbine with Dry Steam.

If now we continue to apply heat, the temperature will not increase. The entropy, however, will continue in increasing values to the right, consequently the straight line DE represents our curve under these conditions, until finally the point E is reached when all of the water becomes evaporated into steam.

Should we now connect up all of the points of saturation on this diagram, the curve EF' would be the result. The combination of curves BD and EF' is known as the "steam dome." If the steam in our steam turbine or in the reciprocating engine expands adiabatically and at the same time iso-entropically we will finally arrive at the point F vertically below E. This point represents the condition of the steam in the condenser and is plotted to represent that temperature. At that temperature the steam is now condensed into water which is returned to the hot well. The entropy in the water under condensation decreases to C, so as to make an enclosed figure or cycle of operations as shown in the area CDEF. This cycle of operations is known as the Rankine or Clausius cycle and to this ideal cycle is referred the operation of all reciprocating and steam turbine operations. This of course can never be realized in practice but it is always used as a basis of comparison when speaking of the absolute efficiency of either the steam turbine or the steam engine.

By computing the area CDEF, we obtain at once the heat units in every pound of steam which have gone toward useful work. The ratio of the area CDEF to the area KCDEH will give us the ideal efficiency beyond which it is absolutely impossible to ever improve turbine economy.

Looking at these areas, let us see if we can derive some simple formula by which we can compute them without the use of a planimeter. The total heat of the steam at 373.1 degrees F. or 180 lb. abs. pressure is represented by the area OBDEH, which let us call H_1. On the other hand the total heat represented by saturated steam at the temperature of 101.8 degrees or one pound absolute pressure is represented by OBCF' H', which let us call H_2. The area of HFF' H' is seen at a glance to be $(n_2 - n_1) T_2$, in which n_1 is the entropy of saturated steam at the higher pressure and n_2 at the lower. The energy E, which has gone toward useful work, and which is represented in the

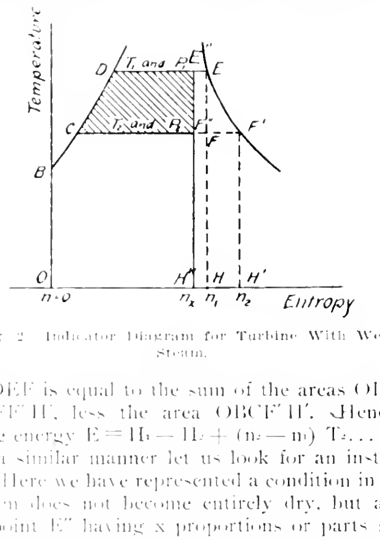


Fig. 2. Indicator Diagram for Turbine With Wet Steam.

area CDEF is equal to the sum of the areas OBDEH and HFF' H', less the area OBCF' H'. Hence we have the energy $E = H_1 - H_2 + (n_2 - n_1) T_2 \ldots\ldots (1)$

In a similar manner let us look for an instant at Fig. 2. Here we have represented a condition in which the steam does not become entirely dry, but arrives at the point E" having x proportions or parts steam, the remainder being suspended moisture. Under these conditions the useful work that has been performed is represented by the area CDE" F". It is evident that this area is equal to the area OBDE" H" plus the area H" F" F' H', less the area OBCF' H'. Hence, assuming n_x is the entropy of the steam at E", we have that the useful energy E is represented by the equation

$E = H_1 - H_2 + (n_2 - n_1)T_2 - (n_1 - n_x) (T_1 - T_2)$ or

$$E = H_1 - H_2 + (n_2 - n_1) T_2 - \frac{L_1}{T_1} (1 - x_1) (T_1 - T_2) \ldots (2)$$

Now let us consider the case in which the steam is superheated. Under these conditions Fig. 3 represents a fair idea of such a resulting diagram. By an identical and similar process to that above the energy E is

$E = H_1 - H_2 + C_{pm} (T_s - T_1) + (n_2 - n_s) T_2 \ldots\ldots (3)$

Let us now take an example and follow the calculations involved in the above three cases, wet, dry and superheated steam. A steam turbine receives its supply at 180 lb. abs. pressure, exhausting the same into the condenser maintaining a pressure of 1.0 lb absolute. Compute the best efficiency beyond which improvement can never be looked for.

Referring to Marks and Davis steam tables, we find the following data:

$p_1 = 180$, $h_1 = 345.6$, $L_1 = 850.8$, $H_1 = 1196.4$, $n_1 = 1.5543$
$T_1 = 373.1 + 459.6 = 832.7$, $p_2 = 1$, $h_2 = 69.8$, $L_2 = 1034.6$
$H_2 = 1104.4$, $n_2 = 1.9754$, $T_2 = 101.8 + 459.6 = 561.4$,
steam superheated 100° F., $c_{pm}\ (T_s - T_1) = 57.9$, $n_s = 1.6201$.

Case I. Let us assume that the entering steam is dry. Substituting in equation (1) we have

$$E = H_1 - H_2 + (n_2 - n_1)\ T_2$$
$$= 1196.4 - 1104.4 + (1.9754 - 1.5543)\ 561.4$$
$$= 1196.4 - 1104.4 + 236.4 = 328.4 \text{ B.t.u.}$$

The total quantity of energy which has, however, been supplied to accomplish this 328.4 B.t.u. of useful work is

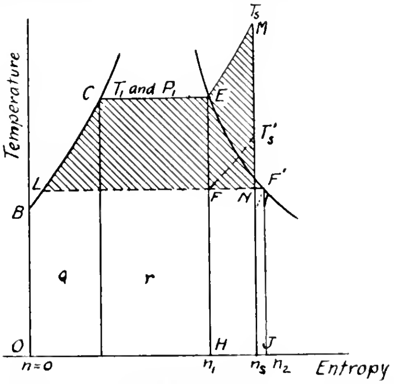


Fig. 3. Indicator Diagram for Turbine with Superheated Steam.

$$H_1 - h_2 = 1196.4 - 69.8 = 1126.6 \text{ B.t.u.}$$

Hence Rankine or Clausius efficiency $= \dfrac{328.4}{1126.6} = 29.16\%$

Carnot efficiency $= \dfrac{T_1 - T_2}{T_1} = \dfrac{832.7 - 561.4}{832.7} = \dfrac{271.3}{832.7} = 32.56\%$

Case II. Let us assume that the entering steam is 5% water. Substituting in equation (2) we have

$$E = H_1 - H_2 + (n_2 - n_1)\ T_2 - (n_1 - n_x)\ (T_1 - T_2)$$
$$= 1196.4 - 1104.4 + (1.9754 - 1.5543)\ 561.4$$
$$- \frac{850.8}{832.7}\ (1 - .95)\ \ (832.5 - 561.4)$$
$$= 1196.4 - 1104.4 + 236.4 - 13.8 = 314.6 \text{ B.t.u.}$$

Total heat supplied

$$= h_1 + xL_1 - h_2 = 345.6 + (.95 \times 850.6) - 69.8 = 1083.3 \text{ B.t.u.}$$

$\therefore$ Rankine or Clausius efficiency $= \dfrac{314.6}{1083.3} = 29.05\%$.

Carnot efficiency $= \dfrac{T_1 - T_2}{T_1} = \dfrac{832.7 - 561.4}{832.7} = \dfrac{271.3}{832.7} = 32.56\%$

Case III. Let us assume that the entering steam is superheated 100° F. Substituting in equation (3) we have

$$E = H_1 - H_2 + C_{pm}\ (T_s - T_1) - (n_2\ n_s)\ T_2$$
$$= 1196.4 - 1104.4 + 57.9\ (1.9754 - 1.6201)\ 561.4$$
$$= 1196.4 - 1104.4 + 57.9 + 195.7 = 345.6 \text{ B.t.u.}$$

Total heat supplied $= h_1 + L_1 + C_{pm}\ \ (T_s - T_1) - h_2$
$= 345.6 - 850.6 + 57.9 - 69.8 = 1185.5$ B.t.u.

$\therefore$ Rankine or Clausius efficiency $= \dfrac{345.6}{1184.5} = 29.05\%$.

Carnot efficiency $= \dfrac{T_s - T_2}{T_s} = \dfrac{932.7 - 561.4}{932.7} = 39.8\%$.

It is thus seen that wet steam decreases the efficiency while superheated steam within certain limits increases the useful energy ratio. Although these amounts are apparently small it is well to bear in mind this fact deduced above. The student may try higher degrees of superheat and he will arrive at a point where its beneficial effect in increasing the efficiency is no longer felt.

By looking at these efficiencies, one melancholy fact stares us in the face, and that is, design a steam engine or turbine with ideal conditions and even then thermodynamic laws are such that less than one-third of the heat energy put in will ever be returned to us in useful work. The Carnot efficiency on the other hand rapidly increases with range of temperatures and it may be that invention in other lines will materially aid us in still further perfecting the heat engine so that this ghastly loss may not occur.

Thermotwisters.

1. A steam turbine operates under 200 lb. abs. pressure and .50 lb. abs. vacuum. Compute the Rankine and Carnot efficiencies when

(a) entering steam is dry;
(b) when entering steam has 10% moisture;
(c) when 200° superheat is used.

GERMAN TELEPHONES.

Telephone lines in Germany are owned and operated by the Government. The telephone service belongs to the postoffice and the telephone lines are operated by the imperial postal authorities, except in Bavaria and Wurttemberg, which have maintained their separate postal services.

There were in 1908 (latest figures available) 33,-441 cities and towns in the German Empire having telephone service. There is no minimum size limit below which localities are shut out from telephone service. Exchanges are put up whenever it appears desirable, without regard to the size of the town. New exchanges are not, however, installed within a radius of 3.1 miles of existing exchanges. There are no towns of importance which have not telephone connections.

The rapid growth of the German telephone service is shown by the fact that the total number of subscribers in the German Empire, including Bavaria and Wurttemberg, was 591,973 in 1905, and 1,040,849 in 1910. The number of conversations in 1905 was 1,207,446,753 and 1,664,662,521 in 1910. It will be observed that the number of subscribers has increased more rapidly than the number of conversations.

The subscription rate varies according to the number of subscribers. In towns having not over 50 subscribers the annual rate is $19.04. It increases gradually to $42.84 for cities having over 20,000 subscribers. The charge for the use of public pay stations is 2.4 cents for a conversation of three minutes. Long-distance tolls range from 4.8 cents for a distance of 15.5 miles or less, up to 48 cents for over 621 miles, for a three-minute conversation.

Telephone equipment is delivered by private firms. The principal German concerns manufacturing purely telephone equipment are located at Berlin, Hanover, Munich, Hamburg, Fuerstenberg, Osterode, etc. The electrical industry is one of Germany's greatest industries. Equipment varies in different exchanges. A great variety of switchboard systems are in use, depending on the needs of the exchanges.

PACIFIC COAST ELECTRICAL JOBBERS' CONVENTION AT DEL MONTE, FEB. 22-23-24. '12.

In convention assembled at Del Monte, the jobbers, the manufacturers, the ladies and visitors, what more was needed as a prelude to a glorious time. Sunshine and good-fellowship complete the picture.

Thursday was devoted entirely to golf, pool and other enjoyments until 8:30 p.m. when the first meeting was called to order. Friday morning while the jobbers were discussing co-operation, the manufacturers were enjoying themselves on the links, on the beautiful drives, at the beach and in the surf.

At 2:00 p.m. the first drive was made in the golf tournament for the Jobbers', Patten and Del Monte trophies. Excellent scores were made considering the high wind the players had to contend with. Mr. T. E. Burger with a net score of 84 won the cups, while R. D. Holabird had the honor of the lowest gross score, 83. The score in detail is given below.

The New Clubhouse

Jobbers' Del Monte and Patton Trophy.

	Gross.	Handicap.	Net.
Averill, F. N.	123	27	96
Berry, W. S.	84	22	97
*Burger, T. E.	111	27	84
Carter, H. V.	113	3	110
Carter, C. H	98	4	94
Dederick, C. R.	120	13	107
Elliott, A. H	121	6	115
Goodwin, W. L.	96	13	109
Graham, N. W.	112	13	99
Hillis, C. C.	93	3	96
†Holabird, R. D.	83	15	98
Hall, C. B.	110	8	102

* Winner. † Low gross score

After dinner an informal dance was held in the ball room while the regular porch climbers' contest was carried on in another part of the house until Saturday morning, when the contest for the manufacturers' trophy was played off. T. E. Bibbins was the winner of this cup with a net score of 81, H. E. Sanderson carrying off the honors of a gross score of 83.

Manufacturers.

	Gross.	H'dcap.	Net.
*Bibbins, T. E.	94	13	81
Demming, W. M.	107	12	95
Gregory, S. B.	110	12	98
Hall (P. & S.) C. B	116	27	89
Oakes, R. F.	No returns.		
Poss, F. H.	110	13	97
†Sanderson, H. E.	83	0	83
Seaver, W. H.	122	27	95
Van Riper, H. T.	129	27	102
Young, Garnett	118	27	91
Strong, E. B.	121	27	94
Vandegrift, J. A.	174	27	147

* Winner. † Low gross score

Following this match the jobbers played for the "Ever Ready" cup. This resulted in a tie between Messrs. Averill, Berry and Hillis with a net score of

Jobbers, Everready Cup.

	Gross.	H'dcap.	Net.
*Averill, F. N.	113	22	91
*Berry, W. S.	91	0	91
Burger, T. E.	125	18	107
Carter, H. V.	94	2	92
Carter, C. H	111	3	108
Dederick, C. R.	116	15	101
Elliott, A. H.	110	0	110
†Goodwin, W. L.	88	5	93
Graham, N. W.	131	10	121
*Hillis, C. C.	101	10	91
Holabird, R. D.	89	5	91
Hartley	127	22	105
Hall, C. B.	121	15	106

* Tied for first, C. C. Hillis won the play off. † Low gross score.

91 and Mr. Wm. Goodwin low gross score of 88. In the finals C. C. Hillis won by one stroke over W. S. Berry.

The banquet was held at 7:30 Saturday evening, the ladies being invited. Who but H. R. Warner could have designed a more beautiful setting than that banquet table with a hollow square, the center filled with growing palms, ferns and leaf plants, the white

The Judges.

linen dotted with myriads of stemless violets and places set for sixty guests. T. E. Bibbins in his always happy manner presided as toastmaster. Mr. Roscoe Oaks well named "Ever Ready" was in evidence here as in all of the games, the ballroom, the Monte Carlo and in fact as J. A. Vandegrift most aptly put it "as busy as a one-armed paper hanger covering the ceiling and afflicted with the hives at the same time." Mr. Oakes presented each guest at the table a miniature "Ever Ready" flashlight. At a signal the lights were out and the banquet room in total darkness, it was but a few seconds when myriads of mazda fire-flies seemed to be surrounding the table. from this moment the fun began.

A most delicious repast was served, interspersed with short talks from Mr. J. A. Vandergrift, Mr. R. F. Oakes, who responded to the toast "Ladies"; Mr. A. S. Moody, "California"; R. D. Holabird, "The Goddess of Chance"; H. E. Sanderson, "The Manhood of Chance"; Messrs. W. M. Demming and F. H. Poss, "Golf and Reasons Why." Mr. C. C. Hillis gave a most able address on "Co-operation and Good-fellowship," and was followed by Mr. Thos. I. Stacey, secretary-treasurer of the Electric Appliance Company of Chicago. His talk was the hit of the evening and ended with a statement that as "I am somewhat rusty on the subject of golf and as this is a golf dinner I feel somewhat out of place, but if it were an automobile gathering I could perhaps give you some little advice as to how to start an automobile, gleaned

from sad experience, and if I may be allowed I will read a few rules that I have had printed that may be of value to some of you at least." The rules are as follows:

1. Remove sparkplug, empty carbureter—and crank the engine.
2. Sandpaper the flywheel, take off the commutator—and crank the engine.
3. Kick the pup, blow cigarette smoke in the priming cocks—and crank the engine.
4. Disconnect the speedometer, reverse the windshield, empty the gasoline tank—and crank the engine.
5. Repeat a verse from the Koran, tie a wet towel about the cylinders, take off the mud guards—and crank the engine.
6. Take the motor entirely apart, put it together with your fingers crossed, drop a quarter in the tank—and crank the engine.
7. Crank the engine suddenly, without doing anything else. This often surprises it into running.
8. Turn your coat inside out, oil the tail light, throw the gasoline strainer over your left shoulder, stuff a cushion in the flywheel—and crank the engine.
9. Put a gumdrop in the cylinder, roll up your cuffs, connect the batteries with your watch, take off your necktie, yell "Hell!" into the gasoline tank—and crank the engine.
10. If your engine does not start with rule nine you have failed somewhere in carrying out the directions in the preceding rules and should begin again with rule one, proceeding as before, but more carefully.


Perfect

Several golf cups were presented to the jobbers, including one by J. A. Vandergrift, a jobbers' and manufacturers' cup; T. E. Bibbins, a manufacturers' and jobbers' cup; Mr. W. H. Seaver, a free-for-all lowest gross score, to be played for at the meeting in May and the Journal of Electricity, Power and Gas presented a cup to be contested for by the ladies of both the jobbers and manufacturers and to belong to the lady who wins it twice in succession or three times in one year.

Following the banquet, the regular Saturday evening Del Monte hop was enjoyed by all.

The contestants in the pool tournament were: Messrs. Seaver, Goodwin, Halliday, Averill, Hall, Graham, Moody, Dederick, Berry, Burger, Fowden, Holabird, Vandegrift, Sanderson, Gregory and Mirk. The finals were between Messrs. Graham and Sanderson and won by Mr. Graham, 15-5.

The manufacturers were represented by F. H. Poss, Benjamin Electric Company, Chicago; T. E. Bibbins, General Electric Company, San Francisco; W. M. Demming, General Electric Company, San Francisco; Thos. I. Stacey, Electric Appliance Company, Chicago; W. H. Seaver, U. S. Steel Products Company; H. E. Sanderson, Bryant Electric Company; J. A. Vandegrift, Oakland Warehouse Company; J. B. Hall, Pass & Seymour Company; Roscoe Oakes, American Ever Ready Company; W. M. Murray, National Carbon Company, Cleveland; S. B. Gregory, Arrow Electric Company; A. S. Moody, General Electric Company, Portland; Garnett Young, Telephone Electric Equipment Company; E. B. Strong, Journal of Electricity, Power and Gas.

Members of the Electrical Supply Jobbers' Association of the Pacific Coast, who were present at Del Monte meeting were: F. N. Averill, Fobes Supply Company, Seattle, Wash.; W. S. Berry, Western Electric Company, San Francisco; T. E. Burger, Western Electric Company, Los Angeles; C. H. Carter, Pacific States Electric Company, Los Angeles; H. V. Carter, Pacific States Electric Company, Oakland, Cal.; Chas. Wiggin, Dunham, Carrigan & Hayden, San Francisco; C. R. Dederick, Dederick Electrical Supply Company, Portland, Ore.; Frank Fowden, Brooks Follis Electrical Company, San Francisco; Ross Gilson, Gilson Electrical Supply Company, Oakland, Cal.; W. L.


New Links

Goodwin, Pacific States Electric Company, San Francisco; H. W. Graham, Holabird-Reynolds Company, Los Angeles; Ross Hartley, Pacific States Electric Company; Portland, Ore.; C. B. Hall, Illinois Electric Company, Pasadena, Cal.; C. C. Hillis, Electric Appliance Company, San Francisco; R. D. Holabird, Holabird-Reynolds Company, San Francisco; R. E. Kendrick, Kendrick Electric Company, Seattle, Wash.; F. N. Averill, Fobes Electrical Supply Company, Seattle, Wash. The newly elected officers are C. C. Hillis president; Albert H. Elliot, secretary, and C. R. Dederick, member executive committee.

CLEVELAND ELECTRICAL LEAGUE.

The success of the entertainment features of the National Electrical Jobbers' Convention at Cleveland, Ohio, in February was largely due to the energetic efforts of the Cleveland Electrical League, which also has the credit for inaugurating the People's Electrical Page. The program for the meeting had for its cover a miniature representation of this page, as did also a number of large posters with the Jovian insignia in colors. The paper napkins for the banquet were likewise adorned. At the Jovian rejuvination 62 new members were admitted, and all the jobbers were unanimous in agreeing that Cleveland's hospitality was most royal.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Hydraulic Engineering

In the leading paper of this issue is found the beginning of a series of articles on hydraulic engineering by Geo. J. Henry, Jr. The name of Henry so thoroughly permeates hydraulic power plant installation and equipment it seems unnecessary to go into details in setting forth the experiences from which Mr. Henry has drawn his information for this series. Suffice it to say that scarcely an installation of the West, including the islands of the Pacific, has been accomplished without feeling his masterly stroke in the design of some part of its make-up.

Men of such vast experience, of necessity transmit their energies under such high tension as a rule, the profession at large is forced to acquire their ideas not from the lips of the hydraulic engineers themselves, but by visiting their performances of human accomplishment in the canyons, where they are silent but impressive monuments to the skill and energy of our day. Seldom do we have an opportunity of reading in their own words the inner expression which gave forth such accomplishments of constructive imagination.

Few men are better informed than Mr. Henry on the subject of the design, construction and installation of tangential and turbine water wheels, and none are better qualified through practical experience or power of expression to step this information down to the engineering fraternity.

Electrical Supply Jobbers' Meeting

The Good Book has long since informed man of the beautiful provision made in Nature for the satisfaction of every human want; for, in the Twenty-second Psalm, we read "My cup runneth over, I shall not want." The Electrical Supply Jobbers' Association at their recent Pacific Coast meeting at Del Monte have even gone one point beyond the Biblical provision by seeing to it that there shall be no scarcity of cups to take advantage of nature's generous offer.

Although the cups donated in this instance look toward the promotion of keener competition in their outing contests in the health-giving game of golf, the electrical jobbers are nevertheless, to be congratulated upon the part they are taking in boosting the electrical industry in general and co-operation and good-fellowship in particular. Their comradeship and good feeling toward each other are proverbial, and the promotion of such comradeship and good-feeling is what makes our electric profession today—a profession of energy, uplift and progress.

Patent Reform

Many prominent inventors, among them Thomas A. Edison, Peter Cooper Hewitt, and Ralph D. Mershon, have through their organization, the Investors' Guild, petitioned President Taft to take early action in securing patent reform.

The petition sets forth that although congress is constitutionally authorized "to promote the progress of science and useful arts by securing for limited times to inventors the exclusive right to their respective discoveries," the present protection afforded is, far from

secure. The petition proceeds further to state that the delay in securing a patent and the exclusive right granted is so often infringed; that modern centralization of industrial power tend to restrain inventors in their work as well as the sale of their patents; and that the inventor is discouraged in his work consequently the nation is suffering from apathy, resulting from this unfortunate combination.

The petition bearing the signature of such men can but bring forth the earnest consideration of the President and Congress. While it concludes by merely requesting an investigation of present methods without suggesting improvements, it is to be hoped careful thought will be given to details of improvement at the proper time, for much good or harm to our nation is likely to be the result in the proper nurturing or hindering of invention.

Tests of Eucalyptus Pin Insulators

The stupendous growth of the California eucalypts has long been the marvel of all, so great is its upward development and so deep its downward root extensions. Thousands of acres of California lands, not otherwise available, have thus within recent years been given their opportunity to bear a portion of the burdens in production for a great commonwealth.

Much study has been given by the government agricultural stations and the Forest Service in the collecting of reliable data on this recent industry. Recent experiments indicate that the eucalypts seem to have a higher tolerance for carbonate of soda than do many orchard trees, and hence are apparently not sensitive to very large amounts of the sulphates and of common salt if distributed through the upper soil, instead of being accumulated on the surface. But to the electrical man, the continued returns of thoroughly reliable data, indicating especially the superiority of eucalyptus insulator pins, are of intense interest.

Some years ago, the Forest Service collected data from these tests, which showed that a thirty-year-old blue gum is stronger than hickory, and that a fifteen-year-old sugar gum is nearly as strong as black hickory and 91 per cent as strong as second-growth hickory. This is a remarkable showing. More recent tests are even more forceful. Elsewhere in these columns will be found the results of a series of tests in which eucalyptus is plainly shown to be superior to hickory, especially when used in sizes suitable for the insulator pin. Tests are also given in which the eucalypts have been proved in every respect superior to tanbark oak pins.

The Forest Service has collected specimens of eucalyptus from Australia, whence came the California species. The wood is there considered not to be of mature quality until the age of sixty years has been reached. As yet, a growth of thirty years only is possible on the Coast. Since the tests made thus far have been upon fifteen-year and thirty-year specimens, as time goes on, we may look forward to obtaining favorable results in tests upon insulator pins. The growth of the eucalyptus insulator pin manufacture on the Coast is well deserved and should receive the thoughtful consideration of all those having use for the best that can be made. Recent large shipments to Canada and Alaska bear witness to the fact that good things are appreciated abroad as well as at home.

Electric Irrigation Plants

The barren West cries for water; without it, only a howling wilderness is possible, but with its proper application to western soils, no more productive lands throughout the world can be found. The great power companies of the Coast are not asleep in regard to the future possibilities of power consumption in the small pumping plants now being so generously installed in the great valleys of the West.

The electrically operated pump is a source of revenue to the power company and a joy forever to the farmer. In most of our productive valleys an abundance of water is found within 30 to 60 feet below the surface of the ground, and a properly installed electrically operated pump possesses many advantagts superior to any other known mechanism accomplishing the same end. The water is under the complete control of the land owner and he is not dependent in any sense upon his neighbors, for his supply stands ready to be applied at any instant, day or night. There are no boilers to explode, no gasoline tanks to catch fire, and above all, a perfect operation is possible without complicated parts to keep in constant repair. It is cheaper to install and costs less to operate, and this cost never fluctuates throughout the year. The complete equipment is easily started almost instantaneously, and, in the parlance of the up-to-date farmer, "it is on the job, day and night."

Above everything else, the electrically operated pumping plant makes the farm a more livable place. It lessens the so-called "continual round of pleasure" in performing the daily chores, for it brings power to the barn and with it the possibilities of delicate dishes for the invalid and a Sabbath day's rest for the housewife. A thousand comforts are added to the daily life on the farm. The house, the cooler, and the barns can be lighted at any moment in sudden emergencies. Lower insurance rates on the barn and house make security and economy possible to a higher degree. A cool breeze provided by an electric fan is ever ready for the hot summer day, while a gentle warmth for the chilly spring and autumn days is possible from the electric heater. The long winter evenings strengthen the family ties by making the home more enjoyable with the soft, pleasing yet clear steady light of the electric lamp.

The great power companies, realizing the possibility of aiding in the development of prosperity and happiness in agricultural communities, deserve much credit for their co-operative spirit along these lines. The data they have gathered for practical instructions in installations of electric pumping plants is invaluable. The Pacific Gas & Electric Company of Central California has amassed much of this kind of information. In this issue of the Journal will be found the compilation of these data.

The independence enjoyed by the farmer, when electrically operated pumps are installed can hardly be conceived, without comparing his new surroundings with the previous condition of servitude under which he labored before. An opportunity of power consumption of electrical horsepower by the millions is thus opened to the great power companies and happy homes by millions are thus made possible in every commonwealth of our western empire.

PERSONALS.

C. R. Dederick of Seattle visited San Francisco and Del Monte last week.

E. M. Sanderson of the firm of Sanderson & Porter, of New York, was at Seattle during the past week.

S. W. Russell, superintendent of the Northern Electric system at Sacramento, was a recent San Francisco visitor.

J. A. Vandegritt of the Oakland Warehouse Company, left for Los Angeles, via Del Monte on Thursday of last week.

George H. Battee, representing the Electric Agencies Company, has returned to San Francisco from a Northern trip.

C. B. Johnson, a construction engineer for the General Electric Company, was at San Francisco during the past week.

G. R. Murphy, manager of the storage battery department of Pierson, Roeding & Company, is at Seattle on a business trip.

T. S. Clark, of Bates & Clark, electric and hydraulic engineers, has returned to Seattle from a two months' Eastern trip.

C. Remschel, formerly manager of the American Electric Company at Seattle is at San Francisco where he desires to locate.

Frank C. Kelsey, consulting engineer, has been appointed engineer in charge of a municipal water system for Centralia, Wash.

M. G. Garhart, formerly with the Seattle office of the Western Electric Company, has been appointed city electrician at Tacoma, Wash.

Robert McGlynn, formerly engineer with the United Light & Power Company, has joined the Farnsworth Electrical Works, San Francisco.

C. H. Ray of Medford, Ore., is at San Francisco visiting with Frank H. Ray, who is one of the directors of the Great Western Power Company.

W. M. Murray of the National Carbon Company, Cleveland, Ohio, left Los Angeles last week on a visit to the jobbers' convention at Del Monte and is now at San Francisco.

George M. Turner, formerly superintendent for the Washington-Oregon Corporation, has been promoted to manager, with headquarters at Chehalis, Wash.

M. M. Martin, manager of the Humboldt Transit Company's electric street railway system at Eureka, has been spending a few days at San Francisco.

Arnold Pfau, hydraulic engineer, with the Allis-Chalmers Company's Milwaukee office, has returned to San Francisco, after visiting Seattle and intermediate points.

F. N. Averill of the Fobes Supply Company, Portland, was in San Francisco last week on his way to Portland from the East. He attended the Jobbers' Convention at Del Monte en route.

Frank E. Cronise, who was formerly connected with the new business department of the Pacific Gas and Electric Company, has joined the office force of N. W. Halsey & Co. at San Francisco.

A. S. Moody, sales manager of the Portland house of the General Electric Company, was a visitor in San Francisco last week, attended the Jobbers' Convention and returned to Portland Sunday evening.

Wallace W. Briggs, assistant sales manager of the Westinghouse Electric and Manufacturing Company, has just returned to San Francisco after spending nearly a month in Los Angeles and Southern territory in connection with his generator contracts for the Los Angeles aqueduct and other business.

J. B. Hall of Pass & Seymour, Solway, N. Y., is at San Francisco contemplating the establishment of headquarters for his company. Mr. Hall will have charge of the sales department of the entire West.

George I. Kinney, manager of the California department of the Fort Wayne Electric Works, has returned to San Francisco after making a business trip to Los Angeles accompanied by J. W. White of the sales department.

R. S. Buck, of Sanderson & Porter, arrived at San Francisco last Tuesday from New York via Los Angeles with his family. He will make his future headquarters at the San Francisco office of the firm and will reside at Berkeley.

Thos. I Stacey, secretary-treasurer of the Electric Appliance Company of Chicago, and wife, was a recent visitor in San Francisco and Del Monte on his return from the Hawaiian Islands. He left Sunday evening, February 25th for Chicago.

S. L. Napthaly has resigned as general manager of the Great Western Power Co. to take charge of the Oakland-Antioch Electric Railway. His duties have been assumed by vice-president A. W. Bullard until his successor is appointed.

William A. Doble, chief engineer of the Pelton Water Wheel Company, has returned from Los Angeles, where he spent some time on business connected with the large water wheels for the Los Angeles aqueduct, which are to be constructed at the Pelton Company's Pacific Coast factory.

A. C. Sprout, supervising engineer on the Klamath River development of the California & Oregon Power Company, is again on the work, after spending a week at his San Francisco office in connection with the plans for the generating plant. Sidney Sprout arrived at San Francisco from Siskiyou County during the past week to close contracts for the first 10,000 kw. hydroelectric unit of the above installation.

Jacob Furth, president of the Seattle Electric Company and chairman of the board of directors of the Seattle National Bank, has been elected president of the Puget Sound Traction, Light & Power Company, the $10,000,000 corporation, which is about to take over the properties in the Pacific Northwest managed by Stone & Webster. R. T. Laffin, district manager of Stone & Webster, has been elected vice-president of the company.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

The Power Committee of the California State Association of Electric Contractors held a meeting in Bakersfield Sunday, February 25. The following members were presented President J. C. Rendler, J. S. Reynolds, W. A. McNally, C. V. Schneider, L. Levy and Secretary W. S. Hanbridge. H. Miller and Seth Cohn were absent on account of sickness. A long session was held lasting from 8 a. m. until 8 p. m., the members stopping only for meals and a short recess to look over Bakersfield's new court house. The conditions existing were carefully gone over and many suggestions for improvement were forwarded to the National Electrical Contractors' Committee, who will meet a committee of the National Electric Light Association. In order to bring out the points that were being taken up, the committee held a debate lasting a couple of hours. Messrs. Rendler, the secretary and Hanbridge taking the central station side, and Messrs. Schneider, Reynolds and McNally the contractors' side. The subject was, "Resolved, that the central station is justified in selling lamps and appliances and doing wiring." It was a very spirited contest and both sides had their subjects well in hand, and it enabled the committee to see things very clearly. It was decided to let the whole committee be judges, and it was decided as follows: Resolved, That it is to the best interests of both electrical dealers and contractors and central stations to co-operate for the mutual benefit of all, and to hold regular meetings at which should be discussed the most practical and economical manner in which a maximum amount

of current can be sold to the consumer, thus developing the business of all and retaining a satisfied customer.

The State License Committee, consisting of Messrs. Rendler, Reynolds and Hanbridge, held a short session and decided to raise funds for the purpose of having a proper license law drawn up and presented to the next legislature.

The local contractors were invited to become members of the State organization, which they all accepted and President Rendler formed a new local called Kern County No. 15.

The members of the committe then left for home well satisfied with the meeting.

The business conditions in Bakersfield are reported by electrical contractors, are good. The new court house is about finished and now the gardeners are laying out the lawns. This building was wired by the Turner Company and the fixtures manufactured by the Thos. Day Company, both of San Francisco. It is entirely lighted by Mazda lamps and the rooms are all well lighted. F. Meyers of San Francisco is the architect.

TRADE NOTES.

The Western States Gas & Electric Company, through H. L. Jackman, the Humboldt County manager, has ordered a Curtis steam turbine from the General Electric Company, for early delivery. This will be installed at Eureka, so as to double the generating capacity of the station during the coming summer.

Ross Hartley of Portland and C. H. Carter of Los Angeles, branch managers of the Pacific States Electric Company, have been in San Francisco for the past week attending the managers' annual meeting. On Monday evening, February 26th, the annual sales managers' meeting and banquet was held at the Techau Tavern.

The Pacific Gas & Electric Company is installing in its Fern Avenue substation, San Francisco, a Type 43 Gould storage battery of 152 cells for emergency use on the Edison three-wire system. It measures six feet from the floor to the top of the tank. Each cell contains 43 plates. There are four motor-driven high-speed self-regulating end-cell switches. The capacity of the battery is 10,000 kilowatt minutes. A similar storage battery is held in reserve at Station I on Eighth street.

The first car equipments for the Oakland & Antioch Railway have arrived at Oakland. There are two Westinghouse Type H L multiple control, quadruple equipments, the motors being of 75 h.p. each. The combination cars about 55 feet in length, are being constructed by W. L. Holman & Son. A powerful electric locomotive with eight 42-inch driving wheels will be shipped from the Westinghouse works for this road about May 1. Direct current at 1200 volts will be used on the line.

It is announced that the Pelton Water Wheel Company will build for use at the Alaska Treadwell Gold Mining Company's new Nuggett Creek development a special Pelton tangential water wheel unit with a capacity of 1900 h.p. under 490 feet head at 300 r.p.m. A General Electric generator will be direct-connected to the wheel. This unit will be equipped with a special form of needle regulating nozzle actuated directly by the governor. It is also provided with an auxiliary relief nozzle mechanism so designed as to afford the highest degree of water economy. It is claimed that danger of water hammer under a rapidly fluctuating load is prevented.

THE JOVIANS.

H. E. Sanderson, the new Jovian Statesman for California, is preparing for an aggressive campaign. He has just received a new booklet entitled "The Answer," by Ell C. Bennett, Mercury, which explains just what Jovianism means. Mr. Sanderson will be pleased to mail the booklets to all who are interested and will send a request to him at 609 Mission street.

BOOK REVIEWS.

The Steam Engine and Turbine. A text book for engineering colleges. By Robert C. H. Heck, M.E., Professor of Mechanical Engineering, Rutger's College. Size 6x9 inches; 631 pages; 402 illustrations; durable cloth binding. Published by D. Van Nostrand Co., of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $5.00.

Professor Heck has put into this treatise a masterly detail in steam engineering. The textbook idea and the purpose of class-room use have continuarlly been kept in mind. Mechanical form and manner of working are illustrated by selected, typical examples of construction; rational theory is built up, from fundamental concepts to the fully-developed ideal steam engine; and actual performance is studied and compared with the ideal, an especial effort being made to set forth clearly and logically the empirical knowledge which must fill the gap between them. An excess of mathematics is avoided, preference being given largely to graphical methods. The numerical examples which appear throughout the work, emphasize the quantitative side of the subject, and suggest problems for class-room use. Steam tables appear in the rear of the volume. They are slightly different from those of Marks and Davis, but are founded on the same experimental data. The steam turbine is handled in a scholarly manner and the cross-references met with throughout the discussion is most helpful to the student.

The book is carefully compiled and is to be recommended to the earnest consideration of those desiring a treatise on steam engineering, especially for that portion of the subject that relates to the steam engine and turbine.

Electric Discharges, Waves and Impulses and Other Transients. By C. P. Steinmetz, A. M., Ph. D. Size 6x9 inches; 150 pages; 64 illustrations; cloth binding. Published by McGraw-Hill Book Co., of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.00.

C. P. Steinmetz, past president of the American Institute of Electrical Engineers, needs no introductive bow to electrical men the world over. Mr. Steinmetz in the past years has enriched our mathematical knowledge in electrical phenomena beyond description in words. The predetermination of electric phenomena in steady flow of power is now about complete. Generators, motors, transforming devices, transmission and distribution conductors can, with relatively little difficulty, be calculated, and the phenomena occurring in them under normal conditions of operations, be correctly computed before their occurrence. Phenomena occurring, however, under abnormal voltages, currents and frequencies, though by no means infrequent, are nevertheless little understood as yet. In a masterly manner Mr. Steinmetz has previously set forth a systematic study of such phenomena in a work entitled "Theory and Calculation of Transient Electric Phenomena and Oscillations." The book just presented is a simple physical study of the more difficult head-splitting mathematical deductions derived in the previous publication. Students undertaking the study of transient phenomena will find it profitable and instructive to read the latest publication first.

Motors, Secondary Batteries, Measuring Instruments and Switchgear. Electrical installation manuals. By S. Kenneth Broadfoot, A. M. Inst. E. E. Size 4x6½ inches; 96 pages; illustrated; clear type; strong paper; durable cloth binding. Published by D. Van Nostrand Co., of New York, and for sale by Technical Book Shop, 106 Rialto Bldg., San Francisco. Price seventy-five cents.

In this little book the author in a clear, simple style sets forth in eighty-five paragraphs, the elements of motors, secondary batteries, measuring instruments and switchgear. The methods to be used in oiling, starting, operating and repairing the above described mechanisms are gone into from their very fundamentals. The hints on faults of motors, circuit breakers and fuses are of much practical value. The book is of convenient pocket size and should find a welcome place in the practical man's pocket.

INDUSTRIAL

A NEW LINE OF MOTOR STARTING RHEOSTATS.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has recently placed on the market, a new line of starting rheostats for series, shunt or compound wound, direct current motors. The manufacturers claim the following important advantages for these rheostats:

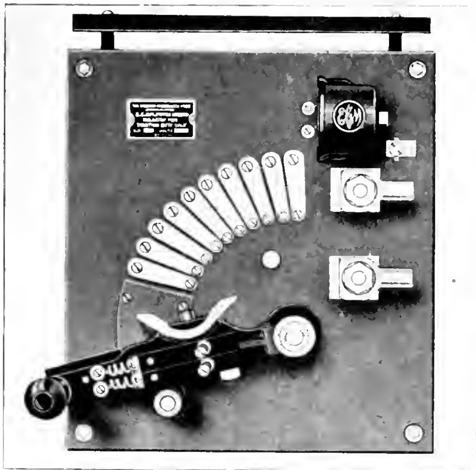


Fig. 1. New Type Starting Device.

The highest grade of Monson slate is used, having beveled edges and oil finish. On all sizes the contacts are removable from the front of the rheostate, without disassembling or interfering in any way with the wiring or resistance. The retaining magnet is iron-clad, thus being protected from mechanical injury. The resistance wire, the capacity of which is liberally proportioned, is wound on asbestos covered, metallic tubes through which a draft of air flows. While this draft of air very efficiently conveys the heat away from the resistance, yet it does not at any time touch the hot resistance wire; the obvious result being unusual freedom from oxidization of the resistance wire.

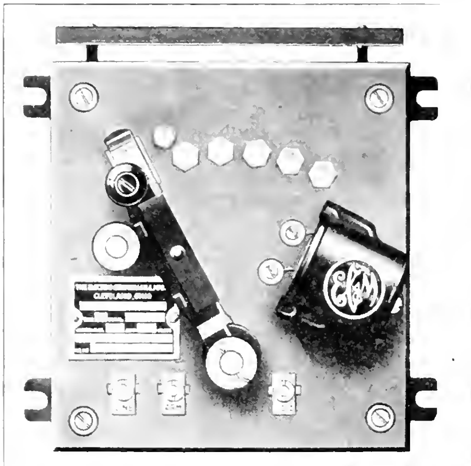


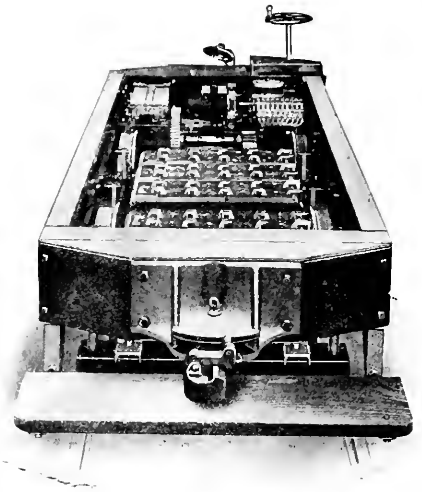
Fig. 2. Improved Type of Control.

The E. C. & M. Motor motor starting rheostats are regularly furnished in sizes from ¼ h.p. to 35 h.p., 110 volts and from ¼ h.p. to 50 h.p., 220 and 550 volts. Starters similar to Fig. 1 will be supplied for motors up to and including 7½ h.p., 110 volts, 15 h.p., 220 volts and 20 h.p., 550 volts. For larger sizes, the starter will be similar to Fig. 2.

STORAGE BATTERY LOCOMOTIVES.

The success of the storage battery equipment for electric vehicles has been so marked that it has been applied to electric cars, electric locomotives, etc. The storage battery locomotive is designed for service where a trolley system cannot be installed or is not desirable, and finds applications especially in short distance hauls at low speeds, such as over the industrial track in and about factory buildings, or where the conditions would require changing the trolley continually as in contractors' service. These locomotives may be built to carry their loads on the platform or to haul trailing loads.

The General Electric Company is now placing a storage battery locomotive on the market. The mechanical design is in accordance with the most approved and up-to-date practice. The frame consists of two steel I beam sides and two steel channel ends, carefully fitted at the joints and held rigidly together with steel angles and heavy bolts. The end frames are faced with wood bumpers to which suitable coupling devices are attached, these latter being designed to suit the customer's cars. The cast steel pedestal jaws which carry the journal boxes are bolted to the lower web of the side frames.



Arrangement of Storage Battery Locomotive Equipment.

The cast steel journal boxes are of special design and are fitted with roller bearings which ensure efficient mechanical transmission of power and so effects economy of battery current. The weight of the car is supported from the journal boxes by two heavy coiled springs.

Brake tension is effected by the screw and nut principle,

the brake spindle having a square thread on which a nut which carries an equalizing bar attached to the brake lever system, travels. This furnishes a very efficient method of braking, as a slight exertion only on the part of the operator is required and the brakes are automatically locked in any position without the use of pawls or rachets.

The wheels are pressed on and securely keyed to the axles. The axles are made of a special grade of steel and are case hardened at the journals so that there is very little wear either on the roller bearings or on the axles.

The motors used are of the automobile type designed to operate from batteries and have characteristics that effect the maximum possible economy in the use of battery current. They have high efficiency, large overload capacity and practically sparkless commutation. The high efficiency is obtained by designing them with a small air gap and running the iron at low densities. Furthermore, on account of the low densities the speed and torque characteristics are steeper than in the case of the ordinary series motors, a feature which tends to reduce the overload which can be thrown on the battery. The armature shaft rotates in ball bearings and consequently the friction losses are very light and the wear of the bearing is practically negligible. The motors are very compactly designed, yet they are readily accessible for inspection and repairs. They are also dust and moisture proof and are mounted in a cast steel suspension cradle, one side of which is supported on bearings on the axle while the other side is spring suspended from the locomotive frame, this manner of suspension being equivalent to standard railway practice. The motor drives the axle through double reduction gearing, an intermediate shaft, supported in the bearing housing and cast integral with the suspension cradle, carrying the intermediate gearing. As the service required of a storage battery locomotive is ordinarily performed at low speed, the use of the double reduction gearing permits slow speeds to be obtained without any rheostat losses and, due to the large gear reduction from armature shaft to wheel tread, very high tractive efforts are obtained at comparatively small current inputs to the motor. When carrying light loads these locomotives have speeds of from 4 to 5 miles per hour while on heavy loads the speed is from 2 to 2½ miles per hour.

The storage batteries are especially designed for the service, being very rugged in construction and due to the use of specially constructed plates have high ampere hour efficiency. The battery cells are grouped in four or more trays and are mounted in an angle iron crate which is spring suspended from the locomotive frame.

ANNUAL CONVENTION H. W. JOHNS-MANVILLE CO. ELECTRICAL DEPARTMENT MANAGERS AND SALESMEN.

On February fifth, there assembled in the new Manville Building, Madison avenue and Forty-first street, New York, over one hundred men who had arrived from all parts of the United States and Canada to attend the annual convention which the H. W. Johns-Manville Company hold for their electrical department managers and salesmen.

J. W. Perry, general electrical manager, called the convention to order and briefly outlined the purposes of the meeting. The first subject was "Modern Illumination", by W. H Spencer, illuminating engineer of I. P. Frink Company, the sole selling agency of which has recently been acquired by the H. W. Johns-Manville Company. "J-M Linolite" was thoroughly taken up by W. S. Kilmer, the company's illuminating engineer. Actual service demonstrations were given in the evening of bank and desk reflectors, direct and indirect lighting fixtures and some new types of Frink electroliers and lighting novelties.

Tuesday was devoted to a discussion of "J-M Linolite Lamps" by J. F. Meyer; "Westinghouse Lamps" by Norman MacBeth and T. F. Fisher; all three of these men being connected with the Westinghouse Lamp Company. "J-M Transite Asbestos Wood" was discussed by S. A. Williams, W. D. Ligon, S. P. Russell and F. C. Reilly. "J-M Fibre Conduit" by W. D. Ligon and W. R. Seigle, "Overhead Line Material" by C. W. Schultz and W. D. Ligon; "Electrobestos Insulation and Diaelectric Cements" by J. R. McLain.

Wednesday was given up to "Friction Tapes and 'Splicing Compound," by J. W. Perry and H. M. Frantz. "J-M Electroliers" and special heating devices, by J. R. McLain; "J-M Air Brake Cylinder Packing Expanded Rings," by George Christensen; "J-M Dry Batteries," by E. Whitmore; "Lightning Arresters, Trolley Catchers and Retrievers," by W. R. Garton; "Asbestos Products for Electrical Power Plants," by L. R. Hoff.

Two special Pullman cars conveyed the convention representatives, on Wednesday evening, to Hartford, Conn., where the factory of the Johns-Pratt Company is located, and for which company the H. W. Johns-Manville Company are sole selling agents. Thursday morning the men assembled in the convention hall at the factory of the Johns-Pratt Company. J. W. Perry opened the meeting and President E. B. Hatch, of the Johns-Pratt Company, delivered an address of welcome. R. C. Cole, electrical engineer, occupied the entire morning with a discussion of "'Noark' Enclosed Fuses," and in the afternoon the subject of "'Noark' Service, Fuse and Subway Boxes" was handled by D. C. Hooker, assistant electrical engineer. The evening was spent in the testing laboratories of the factory, where many interesting tests of high tension fuses and boxes were made.

Friday was entirely given up to the discussion of "Insulating Materials and Overhead Line Material." The subjects were handled by A. G. Newton and R. B. Lattin, of the Johns-Pratt Company and C. W. Schultz, of the H. W. Johns-Manville Company.

On Saturday, the representatives devoted the morning to inspection of the factory, and in the afternoon an inspection of one of the substations of the Hartford Electric Light Company, where is installed a large quantity of "Noark" high voltage service boxes and fuses. R. C. Buell, secretary of the Johns-Pratt Company, delivered a very appropriate address at the conclusion of the meeting.

Saturday evening, a banquet was given to the representatives by the Johns-Pratt Company, at the Hartford Club, and in addition to those who attended the meetings all week, Mr. T. F. Manville, president of the H. W. Johns-Manville Company; J. E. Meek, manager of the railroad department; H. R. Trainer, manager of the Boston branch, and George F. Spencer, president of the I. P. Frink Company, were in attendance. The closing of the banquet concluded a very interesting and profitable convention, and throughout the entire proceedings the spirit of good fellowship and co-operation predominated, and all present declared it was the most profitable and enjoyable affair it had ever been their good fortune to attend.

NEW CATALOGS.

The Wisconsin Engine Company of Corliss, Wis., W. K. Thompson, Union Oil Building, Los Angeles, western sales manager, are distributing a neat booklet descriptive of the Wisconsin crude oil gas producer.

Smith, Booth, Usher Company of Los Angeles, have issued a well printed and bound 576 page catalog of the comprehensive line of machinery, supplies, pipe and fittings for the equipment of irrigation, power and mining plants, which they carry in stock.

Bulletin No. 23 from the Duncan Electric Manufacturing Company of Lafayette, Indiana, on Duncan Induction Type Watthour Meters for A. C. Service, is being distributed by G. A. Wilbur of San Francisco. This bulletin illustratets and describes this new type watthour meter in an interesting manner.

NEWS NOTES

INCORPORATIONS.

HILLSBORO, ORE. Hillsboro Telephone Company, $25,000; shares $100 each; by O. G. and J. B. Wilkes and G. Stevens.

SAN BERNARDINO, CAL.—Articles of incorporation of the Interstate Telegraph Company, with the principal place of business at Carson City, Nev., have been filed, with $100,000 capital stock. The company will complete telegraph lines in Nevada and California.

LOS ANGELES, CAL. Santa Barbara and Suburban Railway Company has incorporated with capital stock of $750,000. The incorporators are A. A. Maxwell of this city, L. J. Lee of Pasadena, and William Dieterle, E. A. Morphy and Herbert F. Keenman of this county. The Edison Electric Company is said to be interested in the concern.

ILLUMINATION.

CARLTON, ORE.—This town has voted water and light bonds, and work will be started soon.

ANACORTES, WASH. Representatives of the Stone & Webster interests have asked for a franchise for furnishing electric lights and current for power purposes.

MERCED, CAL.—The San Joaquin Light & Power Company is making an estimate and gathering data for a power line extension to Atwater and the surrounding country.

REDMOND, ORE. It is probable that the Redmond electric lighting plant will be doubled in the near future. It is suggested that the change be made from gasoline to wood fuel.

FRESNO, CAL.—By a vote of 5 to 3 the Board of City Trustees has passed to print an ordinance establishing dollar gas, the lower rate to be effective October 1, 1912, for one year.

WATSONVILLE, CAL.—W. H. McConnell of Monterey, successor to the Globe Electric Company, has been awarded the contract for constructing the new electrolier system for this city.

IDAHO FALLS, IDAHO.—An election will be held March 12, 1912, to decide the question of issuing $35,000 in bonds, the money to be used in constructing and maintaining a municipal water system and electric light plant.

NAPA, CAL.—At the meeting of the Board of Supervisors the Great Western Power Company presented an application for a franchise to operate an electric power and lighting company in this county. The board called for bids for the franchise to be opened April 9th, 1912.

ALAMEDA, CAL. The finance committtee will submit to the City Council at the meeting on March 5 a bond proposition for $200,000 for fire department and electric light betterments. Of the total issue, $150,000 is designed for the electric light plant. A new building to house the plant, a new unit for additional generation, supplies for extension of distribution service and real estate for plant extension are included in $125,000 of the $150,000 allotted to the municipal light plant.

RANDSBURG, CAL.—The work on the power line of the Southern Sierras Power Company, is advancing rapidly. Crews are busy assembling the big 60-foot steel towers at present which will be set in a concrete foundation within a few days. The location for the Randsburg distributing station will be in Fiddler's gulch, about half a mile south of Butte avenue. ... May 1 the power line will be finished and this town will be lighted by electricity.

OAKLAND, CAL.—The conference committee of the North Oakland improvement clubs recommended at a recent meeting the passage of a resolution calling upon the City Council to establish a definite sliding scale for the protection of the consumers. Since the three-cornered rate war was inaugurated by the Pacific Gas & Electric Company, the Great Western Power Company and the Central Oakland Light & Power Company, rates in the heart of the business section have been cut to 3c per kw. hour, while in districts unaffected by competition a rate of from 5c to 7c has been charged. The lower rate has been made where the cost of underground installation is from $8 to $10 a foot, and the higher charges have been maintained in the near-by districts where the installation expense is lower. Instances were cited by members of the committee showing that a rate of 7c is charged a block and a half district from a point where the 3c rate is allowed. In the residential sections an average 6c rate is maintained.

PORTLAND, ORE.—There was an enormous increase in the commercial lighting business of the Portland Railway, Light & Power Company for the last quarter of 1911 over the preceding quarter. The figures for the quarter ending September 30, 1911, show that the receipts from commercial incandescents were $179,710.59. The receipts for the last quarter of the year had jumped to $250,052.61, an increase of $80,000, or 38.8 per cent. The receipts from residence incandescents showed a large increase also. During the quarter ending September 30 these amounted to $95,591.77. During the last quarter of the year the receipts totaled $120,209.42. A partial explanation of the growth lies perhaps in the fact that the nights were longer during the last quarter than they were in the preceding quarter. The company's total revenue from the lighting business during the last quarter was, according to the report, $632,340.45; the total expense of the lighting department was $143,432.68.

TELEPHONE AND TELEGRAPH.

DENISON, WASH.—The Denison Telephone Company has been organized here, with O. E. Daniels as president.

ENTERPRISE, ORE. There will be a telephone line built from Enterprise to Swamp Creek, and from Paradise to Flora.

NEZ PERCE, IDAHO. Idaho Farmers' Co-Operative Telephone Company has been incorporated by N. H. Jacob and associates.

GEORGETOWN, CAL.—The residents of the Dry Creek section between this place and Slatington, have decided to erect a farmers' telephone line.

TRANSMISSION.

BAKER, ORE.—The Eagle River Power Company has secured a franchise to run a power line from its plant on Eagle River to this city.

BELLINGHAM, WASH. The Stone & Webster Corporation has made application to erect high power transmission line along Guide Meridian road from Canadian boundary to Bellingham.

TWIN FALLS, ORE.—The Thousand Springs Power Company has issued bonds to the extent of $1,500,000 to finance the new power project. Location Thousand Springs, 12 miles southeast of Bliss.

SHELTON, WASH.—J. E. Wickstrom has applied for a franchise to construct electric power and light poles along certain streets and alleys, also for constructing and maintaining underground conduits.

VANCOUVER, WASH.—The Washington-Oregon corporation is laying out lines for an electric road from here to Puget Sound, taking in Chehalis, Centralia, Olympia, etc. The power rights held by the Western Electric Company, a subsidiary concern, will be utilized on the Lewis River.

BREMERTON, WASH.—The Navy Department has rejected the application of the Elwha Power Company asking that the company's service, soon to be installed on the Olympic peninsula, be used by the government at the navy yard, Puget Sound. The government power plant has capacity sufficient for all present or contemplated needs.

BELLINGHAM, WASH.—In case the County Commissioners give Stone & Webster a franchise to construct pole lines to Lynden and Sumas in order to bring electric current to this city for the operation of the Bellingham & Skagit Interurban, which has been contracted from the Western Canada Company of British Columbia, the Stone & Webster people will expend $200,000 in the work. This is the statement made recently by one of the men prominently identified with the company. It is not anticipated that there will be any objection to the granting of the franchise, the hearing on which has been set for March 4. Notices have been posted throughout the county inviting any who have objections to make to appear on that date before the Board of County Commissioners. Some of the current thus secured will be used for lighting purposes by the town of Lynden.

MONTEREY, CAL.—The Monterey County Gas & Electric Company and the Monterey & Pacific Grove Railway Company have been sold to the Sierra and San Francisco Power Co., which is the United Railways of San Francisco. Besides the electric railway between Monterey and Pacific Grove and the light and power company of this city, the purchasers secure the light and water companies of Salinas. The Sierra and San Francisco Power Co. gets is power in the Sierras and has a transmission line as far as San Jose. That power line is to be extended to Salinas and power furnished to the Monterey and Salinas plants. The new owners purchased the Monterey and Pacific Grove Railway with the intention of making it the nucleus of an electric system that is to cover the whole of the Salinas Valley. It has been announced that the electric railway will be extended from Monterey to Salinas during the coming year.

SEATTLE, WASH.—The stockholders of the Seattle-Tacoma Power Company, at a special meeting last week voted unanimously to affiliate with the Puget Sound Traction, Light & Power Company recently organized for the purpose of taking over nearly all of the large light, power and traction companies in Western Washington. The stockholders ratified a report of the directors that the transfer be made. The action of the stockholders of the Seattle-Tacoma Company marks the passing of that corporation as an independent factor in the lighting and heating field. The company will lose its identity in the new company, which is capitalized at $40,000,000. Even the name will be changed in the near future. The Seattle-Tacoma Power Company developed the Snoqualmie Falls power station and in addition to furnishing power and light, operates a steam heating plant in the business district of the city. The Puget Sound Traction, Light & Power Company will in the near future take over the Seattle Electric Company, the Pacific Coast Power Company, the Whatcom County Railway and Light Company, and the Puget Sound Electric Company. All of the light, power and traction companies will be brought under the management.

TRANSPORTATION.

GLOBE, ARIZ.—Plans are now being formulated for building an electric road from Globe to Miami, and later through to Phoenix via Bellevue, Ray and Winkleman.

SAN FRANCISCO, CAL.—Treasurer McDougald has sold to the Union Trust Company $57,000 worth of 4½ per cent Geary street municipal railway bonds at par and accrued interest. The company bought for clients. McDougald has on hand $292,000 of the $400,000 block of the bonds last authorized.

GLENDALE, CAL.—Sealed bids will be received up to April 1st for the purchase of a franchise granting the right to operate for a period of 44 years an electric railroad on certain public streets of this city.

RICHMOND, CAL.—Superintendent W. R. Alberger of the Key Route systems, has announced that a rapid passenger service from Berkeley, connecting with the San Francisco ferry boats, will be extended to this city during the summer. A right of way has been secured. Alberger stated that branch lines connecting with the many manufacturing plants of the city, for carrying freight, are also contemplated by the company.

SAN FRANCISCO, CAL.—William M. Abbott, general attorney for the United Railroads, appeared before the public utilities committee of the Supervisors Wednesday, asking an extension of time on the Bancroft ordinance to compel the company to give direct service to the ferry on its Sutter street line, using the inner tracks. Without discussion further consideration was postponed one week, with the understanding that Abbott would, before the expiration of that time, present to the committee a proposition on behalf of the company looking toward a consummation of the demand.

PORTLAND, CAL.—In the street railway department of the Portland Railway, Light & Power Company, the revenue from the passenger traffic was $908,782.73 for the final quarter of the year. The receipts from freight hauling totaled $14,681.42 and from miscellaneous sources enough to bring the total to $989,578.95. The total operating expenses were $633,102.54. The company paid a dividend of $249,677.50. The number of passengers carried for revenue was 18,423,430. There were 4,225,252 transfers issued. The number of persons carried free of charge totaled 746,798. The report states that there are 271.28 miles of track in use.

SAN JOSE, CAL.—Within three months' time cars will be running between San Jose and Berryessa, if the plans under which the San Jose-Santa Clara Railway Company is working do not fail. The surveys have been completed, the rights-of-way secured as far as the boundary of Alum Rock Park, and the actual work of construction has begun. About a quarter of a mile of grading has been done in the Berryessa road east of Luna Park, and with a large crew of men the work is being pushed as rapidly as possible. A consignment of 5000 ties is already on the scene of activity, and 30,000 more are on the way to the construction camp. No preparations are be'ng made yet for the continuation of the line into Alum Rock Park, a city reservation, as the franchise through this property has not yet been obtained.

WATERWORKS.

SAN DIEGO, CAL.—Mayor J. E. Wadham vetoed the ordinance calling for special election to vote $600,000 sewer and water extension bonds.

UNION, ORE.—This city is to have a water system to cost $20,000. Two and one-half miles of 12 inch pipe will be put in. Water is to be taken from Catherine Creek.

GRANTS PASS, ORE.—H. L. Walther, manager of the Rogue River Electric Company at Medford, states that his company is coming to this section and will pump water on the land this summer.

MINNVILLE, ORE.—Carlton City is to issue bonds not to exceed $40,000 for water and light purposes. Water is to be taken from Panther Creek. A. L. Richardson, a Portland engineer, has been employed to make a survey. Work is to begin within a short time.

CORNELIUS, ORE.—This city has voted to bonl itself for $27,000 for the purpose of installing a gravity water system. The supply will come from Roderick Creek, five miles from Forest Grove, and will be piped to Cornelius through seven miles of wood pipe.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, MARCH 9, 1912 | NUMBER 10

THE OAKLAND AND ANTIOCH RAILWAY

The census statistics of 1910 gave the population of the Bay Cities of California as 653,449 and that of Sacramento with its tributary district a population of 63,696. It is not surprising, then, that the opportunity to interlink by an electric transportation system these districts, which comprise a population of nearly three-quarters of a million people, should have been developed by local capitalists during the past year.

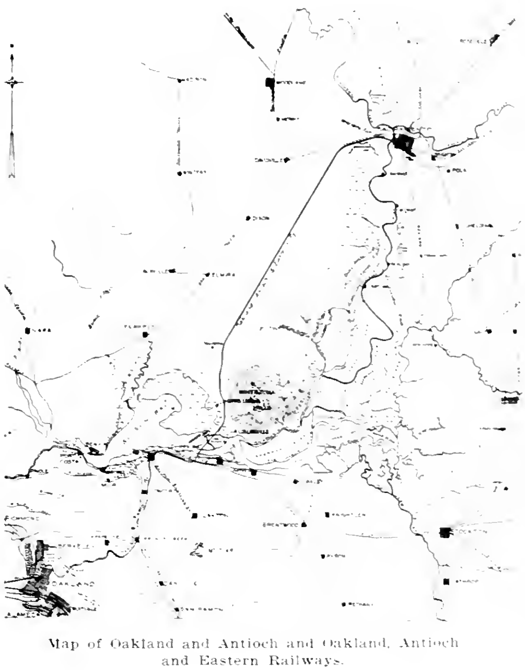
Bay Point Station Showing Type of Car

By reference to the map shown herewith it is seen that the Oakland and Antioch is projected to connect with the Key Route system at Fortieth street and Shafter avenue in Oakland. To the east and north of Oakland the railroad opens up a hitherto secluded but fertile territory, comprising the hamlets of Lafayette, Walnut Creek, Concord and Bay Point. The latter city is the eastern terminus of the Oakland and Antioch Railroad. Recently an extension from Bay Point to Sacramento has been undertaken. While closely affiliated with the Oakland and Antioch, this extension comprises a separate corporation and is known as the Oakland, Antioch and Eastern Railway. The Oakland and Antioch Railway comprises a main line distance of 31 miles, that of the extension known as the Oakland, Antioch and Eastern Railway, from Bay Point to Sacramento, comprises a main line distance of approximately 53.5 miles.

From the Key Route junction at Fortieth street and Shafter avenue, the Oakland and Antioch runs for about 1½ miles along Shafter avenue, one of the principal residential streets in Oakland, and continues thence for at least another mile through one of the best new villa districts of the city. Between this villa district and the tunnel at the summit of the grade, the line extends for about three miles additional. At the summit in the Contra Costa hills a tunnel 3200 ft. in length is being driven to cut the crest of the ridge. From the eastern portal of the tunnel, the line gradually descends into the wide and fertile Mauraga Valley and then it continues on easy grades to its final terminus at Bay Point. That portion between Bay Point and Walnut Creek was put in commercial operation about six months ago.

The Oakland, Antioch and Eastern Railway proceeds from Bay Point to Sacramento and in doing so

extends easterly about 6.6 miles along the south shore of Suisun Bay to a point where a convenient and economical crossing may be effected at an arm on San Francisco Bay. This crossing is made from a point on the south shore about 1½ miles west of Pittsburg, formerly known as Black Diamond. The landing on the north shore is on Chipp's Island. The crossing is a short distance below the confluence of the Sacramento and San Joaquin rivers. The width of the water way is about 3000 ft. The railway trains are to be transferred by ferry. On the north side of Suisun Bay crossing, the Oakland, Antioch and Eastern Railway location lies on tide or marsh lands for about four miles, crossing Chipp's Island and Van Sickle Island to the westerly edge of the Montezuma hills. The two islands are sep-



Map of Oakland and Antioch and Oakland, Antioch and Eastern Railways.

arated from each other and from the main land by narrow sloughs, one of which is navigable and over which will be constructed a drawbridge of about 100 ft. span.

The railway location skirts along the westerly edge of the Montezuma hills by means of a grade not exceeding 0.5 per cent to the Montezuma summit. Thence it descends on a gentle grade to a plain at the foot of the hills near Denverton. From this point on, the located line is to finally cross to the east side of the Sacramento River by means of the Northern Electric Railway bridge, and then enter the heart of Sacramento.

Physical Characteristics.

Beginning at the intersection of Fortieth street and Shafter avenue in the city of Oakland, the Oakland and Antioch Railway climbs a continuous grade to the tunnel above mentioned. The sharpest curve in the construction is 12 degs. 30 min., and is at a point in the hills between Oakland and the summit tunnel. This curve is shown in the heavy cut work illustrated. Aside from this maximum, 10 deg. is the sharpest curve on the first twenty miles and 8 deg. in the valley section below Walnut Creek. For the first 5000 ft. near Shafter avenue the grade is 4.6 per cent compensated, and for the balance of three miles to the summit tunnel, 2.6 per cent compensated. The summit tunnel is 3200 ft. in length and is on a 2 per cent grade descending in the direction of Bay Point. In the descent from the tunnel to the easterly valleys there are also a few short grades, but these are all within the maximum before mentioned, that is, 2.6 per cent compensated for east-bound, and 2 per cent compensated for west-bound traffic.

At the lower end of the valley near Bay Point there is a temporary minor summit with a 3 per cent grade on each side over which trains are now operating. On the 4.6 per cent grade near the Oakland yard a pusher service is to be utilized in the case of the heavier trains, although the lighter trains are expected to operate without pushers, but at slow speed. The topography of the district near Shafter avenue admits of a location having 2.6 per cent grade and at a later date the heavier grade will be eliminated and the latter grade substituted.

All the large culverts on the Oakland and Antioch are of reinforced concrete. In the Walnut Creek section, which is now in operation, there are two plate girded bridges, one of 44½ feet and the other of 54 ft. span. The track is 70-pound rail, rock ballasted. On the 12 miles at the easterly end, 40-pound rails were laid at first, but these are being replaced with 70-pound rails, while this lighter material is being placed in the yard tracks and sidings.

Voltage and Overhead Construction.

The operation is by 1200-volt d.c. overhead trolley, bracket construction, with 0000 trolley wire and the necessary feeders and transmission. Power is bought from the Great Western Power Company, whose lines cross the Oakland and Antioch or pass very closely to it at many points. The substation at Concord is of 600 kw. capacity and in the early future will be increased to 1050 kw. There is another substation at the east portal of the tunnel. Near the Concord station is a temporary carbarn, repair shop and store room. This structure is of wood and is 25 x 60 feet, with one pit and necessary spur and storage tracks.

Oakland, Antioch and Eastern Construction.

The construction on the Oakland, Antioch and Eastern is of the same high class as the Oakland and Antioch with 70-pound rail and rock ballast. It is expected that very high speeds will be attained, especialy on the long tangent between Denverton and Sacramento, and all of the construction and equipment is designed for high speeds and first-class service. On about 30 miles of this section of the line catenary construction is being installed for overhead work with heavy brackets and poles. Track bonds of 0000 capacity are being installed and the line, similar to the Oakland and Antioch, is being operated at 1200 volts d.c., which is to be supplied from the Great Western Power Company; two substations of 750 kw. capacity are being installed.

The standard motor cars for through service are 55 ft. long and have express compartments in addition to a seating capacity for 50. They have an electrical

Roadbed and Cut at Point of Sharpest Curvature.

equipment of four 120 h.p. motors per car. The cars now in use on the Oakland and Antioch, as illustrated, are somewhat shorter and have 75 h.p. motors instead of 120 h.p.

Comparison of Mileage.

As an illustration of the saving in mileage from the cities reached by the Oakland and Antioch, it is interesting to examine the following table, which shows the comparative distance over this line to various stations as compared with those lines already in operation:

	O & A. and connections	So. Pac. Main Line	So. Pac. via Martinez	So. Pac. via Niles	West. Pac.	Santa Fe
S. F. & Key Route Pier	2.6					
Key Route Pier—Shafter Avenue	4.7					
S. F.—So. Pac. Pier		4	4	4		
S. F.—Richmond Pier						10
S. F.—Bay Point	38.1		42			37*
S. F.—Sacramento	91.6	90*	153	140	139	
Oakland—Sacramento	84.3*	85	148	135		
Oakland—Stockton	72.0*		97	87		79
Oakland—Bay Point	36.8*		39			38
Oakland—Martinez	36.8		33*			
Oakland—Concord	25.8*		39			
Oakland—Walnut Creek	19.8*		44			

Note.—In the above table the distances are from the foot of Market street, San Francisco, and from the center of Oakland. The mileage of the San Francisco ferry trip is 2.6 miles for the Oakland & Antioch, 4 miles for the Southern Pacific, about 5 miles for the Western Pacific, and 10 miles for the Santa Fe.

Progress of the Work.

The construction work at the present time is under the supervision of J. G. White & Co., engineers, of New York and San Francisco. The immense cut through which the sharp curve runs passes immediately beneath two towers of the Great Western Power Company. Hence it is necessary that they be removed and actual work is now being undertaken. The tower to the west carries three-phase current at 11,000 and 60,000 volts, while that to the east operates at 110,000 volts, the same being among the highest voltages now in operation.

It is interesting to note the efficient manner in which the yardage in this cut is being handled. A train of four cars, each with a carrying capacity of 1½ cu. yds., is hauled alternately into the tunnel openings shown. Two mules attached to these cars suffice to pull the empty cars to the portal of the tunnel; then by hitching the mules to the wire cable shown on the ground to the left, the journey of the cars into the tunnel is completed without any lost motion on the part of the mules. The men shown on the embankment above the portals constantly direct the lowering of material through traps until each car is loaded by gravity. When the four cars are completely loaded they are then let down to the fill below by gravity. In a word, the entire process, from the time the train leaves the embankment until its contents arrive in the fill

Tunnel Portal.

below, is accomplished entirely by gravity, as the track itself is laid on a 2.6 per cent grade. By means of an occasional blast in the embankment above sufficient dirt is loosened so that the picks in the hands of the men shown above the traps are usually able to keep a continuous train of these cars in motion.

Continuing up the grade to the summit beyond this heavy cut a picturesque side-hill construction work is encountered. In the main foreground is shown the heavy line work necessitated throughout this construction. For heaviness of cut work and permanency of design this interurban line represents more the appearance of a transcontinental railroad than that of an electric interurban. As can be seen in the figure, all the smaller cuts are being day-lighted, since this can be done much

cheaper at this time than at any future period. It also indicates the substantial and permanent character with which the work is being performed.

The tunnel, 3200 ft. in length, is progressing in satisfactory shape, although water with its inevitable slush has had to be summarily dealt with.

The haulage is accomplished by means of a mine type locomotive with Westinghouse controllers, operating at 250 volts, and with a draw bar pull of 1600 lbs. when moving 7½ miles per hour. It weighs 5½ tons and operates by means of two overhead trolley wires. Two lamps in series are located in each end for headlights.

The cars, 18 in all, are made by the Western Wheeled Scraper Company of Aurora, Ill. Power is supplied from the Great Western Power Company's 11,000-volt lines, which pass nearby. In the trans-

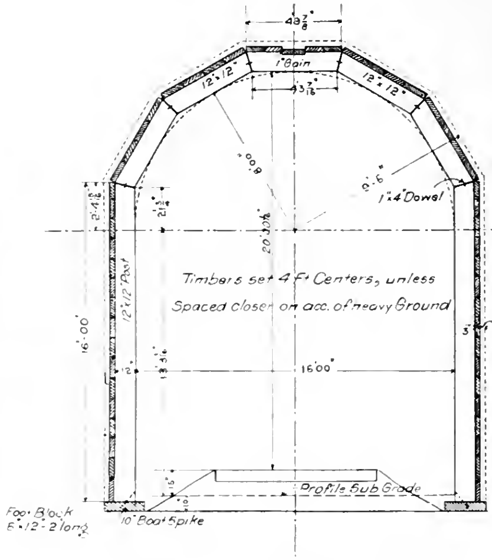
Two-Decked Jumbo Used in Tunnel Construction.

former house are to be found three 25 kw. 10,000 to 480 General Electric air-cooled, oil-insulated transformers. There are also three 25 kw., 11,000 to 460 oil-insulated, air-cooled Westinghouse transformers. The station, which is of corrugated iron, is provided with ample lightning protection.

Alternating current at 440 volts is supplied to an induction motor operating at 720 r.p.m., 122 amperes, full load, which drives a General Electric direct-current generator. This generator delivers current at 250 volts when operating at 730 r.p.m. with a full load capacity of 180 amperes. The output is utilized for power in running the tunnel, fan, saw and electric traction locomotive above referred to. A three-phase, 60-cycle, 75-h.p. General Electric induction motor is used to drive, by means of a belt connection, a Sullivan air compressor which has a capacity of 600 cu. ft. of air per minute. A 15-h.p., 230-volt, 1000-r.p.m. General Electric d.c. motor is used to drive a circular cut-off saw. This saw is rigged up with the necessary guides so that the timbers are shaped to exact size for tunnel work with minimum labor.

The electric locomotive, above referred to, seems to have met every requirement put upon it. Not only is it able to handle the load shown in the picture, but also it operates with ease the big two-deck jumbo, which of necessity must climb the two per cent grade in the tunnel.

The tunnel is now, from the east end, completed for the first 450 feet, and is partially completed a total distance of 500 feet. The tunnel cross-section measures 16 x 22 ft. with 20 ft. clearance from the top of the roof. The top is timbered by means of a five-segment arch. The tunnel is well lagged wherever the material encountered necessities. Whenever the ground was such as to require crown bars and the heading was started before the portal was erected, the crown bars



General Plan of Tunnel Timbering.

project out to within six inches of the face of the portal and are thoroughly wedged between the top of the three-inch lagging and the bottom of the three-inch crown bars. The timbers are all 12 x 12 in. The lagging over the segments are always at least 6 inches wide, while the lagging beyond the post is 4 in., or if the character of the ground permitted, it is omitted.

The excavation in the tunnel amounts to 15.3 cu. yds. per lin. ft., 160 ft. of lagging is required per ft. of tunnel and 688 ft. board measure is required per set for timbering. The timbers are set 4 ft. on centers, unless closer space is required on account of heavy ground. The arch of the tunnel, which, as stated above, consists of five segments and is made of 12 x 12 in. timbers carefully sawed to proper angles and have an extreme length of 4 ft. 10 in.

TRANSMISSION POLE EFFICIENCY.

The Joint Pole Commission, representing the public utility corporations of Los Angeles reports the removal of over 120 miles of poles from the streets of the city through combination of duty for poles and removing the superfluous ones. Combinations were obtained for 4586 poles and 6135 were taken out which saved the corporations over $100,000, lowered rates for telephones, light and power and very materially added to the appearance of the streets. Since the commission was organized five years ago 700 miles of poles, representing a saving of $250,000, have been removed.

OIL FOR FROST PROTECTION.

The U. S. Weather Service in conjunction with the University of California has done much toward frost prevention. Dr. J. Elliot Coit, superintendent of the Riverside Experiment Station, gathered much valuable data during the trying period in December, 1911.

The conditions most favorable for a freeze, are as follows: (1) Clear sky, because radiation is then most rapid. (2) Very dry air, because cooling by radiation will then continue to a much lower temperature before it is checked by the heat liberated by condensation. (3) Still nights, because the air, not being mixed by wind, arranges itself in layers according to its density, and the heavier, colder air collects near the ground in contact with the trees.

Methods of Frost Prevention.

A number of methods have been suggested and tested for preventing or lessening frost injury to citrus trees. Among these the following three have proven the most practicable and effective:

(1) By Diminishing the Radiation of Heat. When any object is interposed between plants and the sky, the dark heat rays are intercepted in their upward course, and their heat made sensible. Hence any covering or other shelter over trees acts as a trap to conserve the heat gained during the day. In parts of Italy citrus trees are sometimes covered with mats of straw or other material laid on trellises. In this country it has proven too costly to cover bearing orchards, but this principle is largely used when lath screen or other shelters are erected over nursery seed bed stock. The protection secured by tying cornstalks around the bare trunks of newly planted trees is due to diminished radiation. The fact that fruits situated in the lower interior of the trees are injured to a less extent than exposed fruits is in like manner due to the trapping of radiated rays by the leaves and branches.

Conversely, clouds or a pall of smoke hanging over the orchard after sunrise will tend to intercept the heat radiated by the sun and cause the frozen fruit to thaw slowly, which is a benefit of considerable importance.

(2). By raising the Dew-Point by Adding Moisture to the Air and Thus Making Sensible the Latent Heat of Condensation at a Temperature Above the Danger Point. The deciduous fruit grower takes advantage of this principle when he maintains many smoldering fires of wet straw in his blossoming orchards. The citrus nurseryman may spray his seed bed stock, but these methods are impracticable in large bearing citrus orchards. Irrigation water, especially if warm, has proven of decided value in those orchards fortunate enough to have the water on frosty nights. The general policy of irrigating copiously during winter in the hope of protection on cold nights is open to the objection that abundant water in the soil may start new growth and render the trees more susceptible to cold than they otherwise would be.

(3) By Adding Heat Directly to the Air Through the Agency of Fires Distributed Throughout the Orchard. It has been demonstrated beyond question that this is the most successful and practical way to handle the frost problem in commercial citrus orchards. A great many devices and many kinds of fuel have been experimented with, and it is the consensus of opinion among the growers who have fought frost that the best fire so far tried is distillate oil burned in some form of sheet-iron receptacle. Experience during the last cold spell shows that the requirements of such a receptacle are as follows: Simplicity, capacity, good combustion and durability.

On account of the quality of labor available and the lack of time on frosty nights, it is very important that the receptacle should be simple and easily operated by the most obtuse workman. Pipes, cocks or valves on an oil receptacle are a serious disadvantage.

Provision must be made in the frosty areas for ten hours of effective firing. Either the receptacle must have large capacity or a sufficient number must be provided to burn in relays. Many small fires are much better than a few large ones. The amount of heat given off by pots when nearly burned out is very much less than when first lighted, hence it is wise to light the alternating receptacles before the first are burned out. Additional extra receptacles should be placed about the orchard and on the windward side for use in case of an emergency. Experience has shown that in an old, fairly thick orchard on a quiet night forty two-gallon receptacles per acre, burning slop distillate, will raise the temperature four or five degrees. With a temperature of 24 or below it will be necessary to have one two-gallon receptacle per tree burning simultaneously at the coldest period of the night in order to save a crop of lemons. It is still better to have not less than 120 per acre, forty of which can be burned early in the night, and the remaining eighty during the coldest period toward morning. The pots that are burned early in the night should be designated with a white band of paint. It often happens that the lighting of the second lot raises the temperature sufficiently high so that the first fires can be dispensed with by covering the receptacles. These same receptacles may need to be lighted again at the coldest period near morning. The white band of paint insures against error in putting out the wrong fires.

As low temperatures are liable to occur on four or five successive nights, it is necessary to have arrangements for storage of oil on the ranch near the orchards. The storage should have a capacity equal to at least five fillings of all the receptacles on the ranch. The ordinary lard pail type of pot of one-gallon capacity will burn slop distillate for about four hours when new, and a little less after repeated burnings. These pots may still have a flicker of flame after eight hours, but they give off heat effectively for only about four hours. The two-gallon heater will heat effectively for about eight or nine hours with the soot collector in place, and about five hours with the cover and soot collector removed. For small isolated orchards, where there is little or no cumulative effect of the fires, a two-gallon heater to each tree with a double row around the windward side should be provided. This applies to large bearing trees, which tend to hold the heat. With small trees still more equipment is advisable.

Results secured during the cold weather of 1912 are interesting. The experience of certain growers shows conclusively that by orchard heating properly carried on, citrus crops may be safely carried through nights when the temperature falls to 20 degrees F., at a cost which is nominal when compared to the value of the fruit.

It is true, however, that there were very many failures. By far the most of these were due to the lack of sufficient heating equipment, to save the crop during the long continued very low temperature which prevailed Christmas night, 1911. In but few cases were growers properly prepared to meet the conditions. Those who began to fire early ran out of fuel long before morning, and those who delayed firing on account of lack of fuel were in many cases unable to raise the temperature appreciably after it had once reached a very low point.

Among those who were prepared to wage a winning fight, the Limoneira Company at Santa Paula, which owns 300 acres of bearing lemons, stands out as a striking example. This company had on its lowlands an equipment of 112 coal baskets and fifty-six two-gallon oil pots to the acre. A night watchman was kept in the orchard whose duty it was to watch the thermometer in the coldest spots and arouse the assistant manager of the ranch whenever the mercury reached 30 degrees. Firing was begun with the first formation of ice in the coldest spots. It was found that it was easier to maintain a temperature of 30 degrees than to restore the heat after the mercury had once fallen much below that point. Usually only every alternate pot was lighted early in the night, and these sometimes proved sufficient, but in case the conditions warranted, the remaining pots were lighted later. In this case the extra equipment saved the Limoneira crop.

Other factors which contributed to the successful outcome on the Limoneira property were the organization of the firing force of sixty men into efficient squads, each under a foreman, and the provision of a huge concrete storage tank for oil so that all the pots could be quickly filled from tank wagons. Firing was practiced thirteen consecutive nights on this ranch. The manager states that there was consumed on this ranch during the thirteen nights of firing 45,000 gallons of distillate, 500 gallons engine distillate, 1400 gallons crude oil for lighting coal baskets and 125 tons of coal. For a total expense of $4726.00, including labor, the crop was saved on 225 acres of lemons. This amounts to $15.75 per acre.

In the light of this experience, it is plain that in order to be prepared for any emergency, the lemon grower on frosty land should be equipped with at least 100 two-gallon receptacles, and preferably 120 per acre, with a double row around the outside in case his acreage is small. He should also have storage for enough oil to fill the receptacles on five or six consecutive nights.

METHODS OF WATER GENERATION IN THE NORTHWEST.

Hydraulic Turbines.

Data has been furnished showing the use of 43 hydraulic turbines, of which 12 are vertical and 31 horizontal.

The 12 vertical turbines are in the plant of the Portland Railway, Light & Power Company, at Oregon City, and are single wheels operating normally under a 37 foot head. An interesting feature about this plant is the use made of 10 turbines of a larger diameter which are belted to 10 of the above mentioned units and are operated during periods when the head is not sufficient to generate the power required, from the smaller units. Of the 31 horizontal turbines, a large majority are either double runners, or single runners with double discharge, and operate under heads varying from 37 feet to 600 feet, the last named head being that at the plant of the City of Seattle.

The largest amount of power generated by any single unit is in the plant of the Seattle-Tacoma Power Company, where the unit generates 12,000 h.p., and the smallest is in the plant of the Washington Water Power Company, where the unit generates 90 h.p.

Very little data is at hand regarding the use of impulse wheels though the City of Seattle reports the use of two units under 600 feet head and the Seattle-Tacoma Power Company four 2500 h.p. units, each unit having six runners and two nozzles. These operate under a head of about 270 feet.

Pelton impulse wheels are used at the Electron plant. Each generator is connected to two wheels and each wheel is operated by a single nozzle under a head of 875 feet. The Lombard governors are used to control these wheels by means of deflecting nozzles.

The governing apparatus at this plant may be said to be fairly satisfactory. While not entirely so, we believe it to be more satisfactory than the governing arrangements in most hydraulic plants. On some occasions the plant has dropped the entire load of 20,000 kw. and the governors would take care of the speed in a satisfactory manner. On other occasions some of the governors have acted satisfactorily, while the performance of others was not.

Steam Turbines.

The Portland Railway, Light & Power Company have two 1500 kw. vertical four stage units and two 2000 kw. horizontal four stage units, both being of the Curtis type.

The Washington Water Power Company have one 5000 kw. vertical four stage, and one 9000 kw. vertical five stage Curtis units.

The Seattle-Tacoma Power Company have one DeLaval 300 h.p. unit.

The Seattle Electric Company has 12,000 kw. capacity in Curtis steam turbines, the units being 8000 and 4000 kw. respectively. The generators are 13,800 volt machines and operate in parallel with the Post street steam plant and the Electron water power plant

The turbines are operated during periods of low water or overload of the water power plant. One marked effect of the steam turbines when operating in parallel with the water power plant is the improved regulation. The water wheel governors are blocked and the turbines allowed to do the regulating for the entire system. This increases the output of the water plant about 6 per cent, as impulse wheels are used and the governors control deflecting nozzles.

Steam Engines.

Only one company, the Portland Railway, Light & Power Company, reports any considerable use of steam engines, and as out of seventeen engines not more than two are the same there is nothing to indicate what might be regarded as the best practice.

The Seattle-Tacoma Power Company have one steam engine of 15,000 h.p.

LAMP EFFICIENCY.

Much information is being furnished to the layman and practicing engineer on economy in light consumption by the engineering departments of the larger manufacturing companies. The National Electric Lamp Association has recently published in Bulletin No. 101 some interesting data. The article discusses, both from the mathematical and practical standpoint, the determination of the proper time at which to discard an inefficient lamp.

The price of the lamp and the rate for energy being given the problem is to determine the operating conditions under which a given type and size of lamp will produce light most economically.

On the assumption that each lamp of a lot would live a length of time exactly equal to the average life of the lot and that the wattage and efficiency were constant throughout life, very simple algebraic expressions could be derived giving the cost of renewals per candle power and the cost of energy per candle power both in terms of the efficiency, as illustrated graphically by Fig. 1. The efficiency at which the downward slope of the renewal curve is equal to the upward slope of the energy line or at which the total cost curve is horizontal would be the efficiency at which light would be produced most economically.

Suppose that a large installation of lamps has been put into service and that enough of this class and size of lamps have been tested to give reliable information as to the depreciation of candle power and wattage during life and as to the distribution of burn-outs with respect to time. Such data might be represented in curve form as in Fig. 2.

At any period of burning, the product of average percentage wattage and percentage mortality (percentage of lamps left burning) will give the percentage of the total initial wattage of the installation which is consumed at the period considered. Similarly the product of average percentage candle power and percentage mortality will give the percentage of the total initial candle power of the installation at the period considered. If the installation is discarded at this period the total renewal expense will be the entire cost of the whole lot of lamps.

Hence, if the areas under these two product curves (Fig. 3) are measured any given percentage of initial candle power, or smashing point, the total renewal expense, total energy consumption and total amount of light produced are determined and the total cost per unit of light can be computed for any price of lamp and rate for energy. If the areas are corrected to correspond to some other initial efficiency, the total cost per unit of light at this new efficiency can be found. The efficiency at which this total cost is a minimum is then the best efficiency for the particular smashing point considered. This best efficiency varies with the price of lamp and cost of energy, being higher (lower in the w. p. c.) for low prices of lamp and high energy later, and vice versa.

It is found that when a particular class of lamp is operated at the best efficiency there is a constant ratio between the energy and renewal elements of the total cost. The fact that this ratio is a constant at best efficiency furnishes a rapid method of calculating approximately the best efficiency.

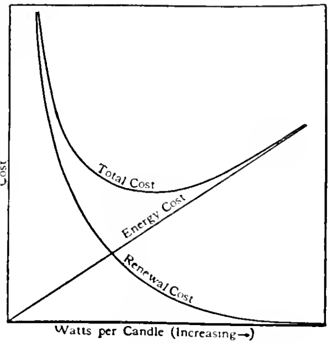


Fig. 1.

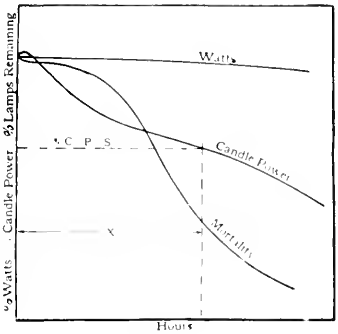


Fig. 2.

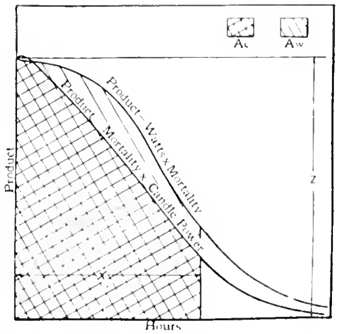


Fig. 3.

Example:—A 40-watt "Mazda" lamp, during 1,000 hours, will consume 40 kw-hrs. At 10c per kw-hr., this energy will cost $4.00. Dividing by 5.84 (see table Ratios of Cost of Lamp to its Life), the proper renewal expense per 1,000 hours is found to be 68.5c. The list price of the 40-watt "Mazda" lamp is 70c and if burned at high efficiency, the average life is 1,000 hours, hence the ratio between renewal and energy expense per 1,000 hours is approximately correct, and the high efficiency rating is therefore approximately correct for 40-watt "Mazda" lamps when the lamps cost 70c and energy costs 10c per kw-hr.

Ratios of Cost of Lamp to Its Life.

Class of Lamp.	b-h	b-h+1	$\frac{1}{b\text{-}h+1}$	K
Carbon	4.24	5.24	.1909	1.629
Gem	4.21	5.21	.1919	1.631
Tantalum	4.21	5.21	.1919	1.631
Mazda	5.84	6.84	.1462	1.516

If the total unit cost of light is computed for various smashing points, and the best efficiency is used for each individual computation, it will be found that for some particular smashing point and corresponding best efficiency the total cost of light per unit is an absolute minimum.

A remarkable feature connected with this smashing point which gives the absolute minimum is that it does not vary with either the price of lamp or the rate for energy, but depends only upon the shapes of the characteristic performance curves of the lamp.

DETERMINATION OF VOIDS IN CONCRETE AGGREGATES.

BY CHAS. DERLETH JR. AND ARTHUR C. ALVAREZ.

Apparatus. One 1000 c.c. or 500 c.c. graduate, one balance with scoop and counterweight, one set of metric weights, one wooden measuring box, one water pail, one galvanized iron measuring cylinder with bottom inlet and tube, scale graduated to tenths of an inch, scales sensitive to one-quarter of an ounce.

Operations. The party will determine the voids in the sand, gravel and broken stone samples separately by each of the methods mentioned. Method 1 will give approximate results only where the particles are less than one-quarter inch in size, since all the air is not expelled by the entering water. It is, however, well adapted for rough determinations in the field, where special apparatus is not always at hand.

In both method 1 and method 2, immerse any aggregate which is absorbent, for thirty minutes, then remove and allow the water to drain well from the surfaces before making the void determination.

Method 1. Determine the volume of the water pail by weighing it first empty, then filled to the very rim with water, and dividing the difference in weight in pounds by 62.4.

Fill the pail with material and after shaking to cause settlement, scrape the top off evenly with a straight edge. Weigh the amount of water which can be added to exactly fill the pail and calculate its volume.

The per cent of voids equals the ratio of the volume of water added to the volume of the pail, times 100.

Method 2. Determine the volume of the cylinder by measuring its average diameter and height to the nearest tenth of an inch.

Place the funnel attached to the rubber tube which leads to the bottom of the measuring cylinder in the lower rack which is level with the bottom of the cylinder. Fill the tube and funnel with water to the bottom level of the cylinder. Fill the measuring cylinder with aggregate. Raise the funnel to the upper rack. Weigh the water which must be added: 1—to reach the top level of the aggregate if the material settles; 2—to fill the cylinder.

Calculate the per cent of voids as in method 1.

For any aggregate which settles, obtain also the ratio of the volume of water, added to reach the top level of the aggregate, to the actual volume of the settled aggregate.

Method 2 is slightly more accurate than method 1, since less air is entranced when small particles make up the aggregate. The per cent of moisture greatly influences the per cent of voids in sands. For sand and in general, method 3 will give more reliable results.

Method 3. Specific Gravity Method. Determine the specific gravity of each of the materials in the following manner: Weigh the glass graduate first empty, then half filled with water. Check the increase in weight with the volume. Weigh out about the same volume of dry aggregate, add and agitate if necessary to remove any air bubbles. Quickly note the exact rise of the water level before the material absorbs any appreciable amount of water.

The specific gravity of the material equals the weight of aggregate added, divided by the weight of displaced water.

Weigh the wooden measuring box. Fill even full with aggregate; shake to cause settlement and weigh again. Calculate the per cent of voids by using the specific gravity above obtained. If the material is not dry, its weight must be corrected for the per cent of moisture present. Determine the per cent of moisture by weighing out about 50 grams, then thoroughly drying in the oven and reweighing.

Mix thoroughly an amount of dry sand and broken stone in the proportions 1:2, by volume shaken, sufficient to slightly more than fill the wooden measuring box. Fill the box even full with this mixture, shake slightly to cause settlement, and obtain its net weight. Calculate the per cent of voids in the mixture.

Tabulate the results of the several determinations.

References. Determination of Voids. 1. Concrete—Plain and Reinforced, by Taylor and Thompson, pages 160-168. 2. A Treatise on Masonry Construction, by Baker, pages 143-146, 101-102, 91-94. 3. Bulletin 23, University of Illinois Engineering Experiment Station, by I. O. Baker.

RESUSCITATION FROM ELECTRIC SHOCK.

The first meeting of the Commission on Resuscitation from Electric Shock was held in the board room of the National Electric Light Association, New York, on Feb. 22. This commission was organized upon the initiative of the National Electric Light Association, and has for a purpose the study of electric shock and the preparation of a set of rules for first aid in case of electrical accident. The commission is composed of members of the American Medical Association, National Electric Light Association and American Institute of Electrical Engineers, as follows:

Nominated by the American Medical Association: Dr. W. B. Cannon, professor of physiology, Harvard University, chairman; Dr. George W. Crile, professor of surgery, Western Reserve University; Dr. Yandell Henderson, professor of physiology, Yale University; Dr. S. J. Meltzer, Rockefeller Institute for Medical Research, New York; Mr. W. D. Weaver, editor Electrical World, secretary. Nominated by National Electric Light Association: Dr. E. A. Spitzka, professor of general anatomy, Jefferson Medical College; Mr. W. C. L. Eglin, electrical engineer Philadelphia Electric Company. Nominated by American Institute of Electrical Engineers: Dr. Elihu Thomson, electrician, General Electric Company; Dr. A. E. Kennelly, professor of electrical engineering, Harvard University.

At the meeting in New York City the medical members of the commission unanimously advocated the Schaefer, or prone, method as the best means in the hands of laymen for maintaining respiration in victims of electric shock, and the commission formally voted to recommend this method. A chart is now being prepared which will give details of first aid in cases of electric accidents and will describe fully the method of applying artificial respiration. This chart will be issued under the auspices of the National Electric Light Association.

GRAPHICAL ANALYSIS OF THE ALTERNATING CURRENT TRANSFORMER.

BY A. L. MENZIN.

As a more complex example of the use of polar diagrams, discussed in the Feb. 17th issue of this Journal, without any reference to the wave theory of electrical phenomena, the alternating current transformer will be considered. Instead of making all the solutions in one diagram, as is customary, the various steps will be developed in different diagrams for the sake of clearness.

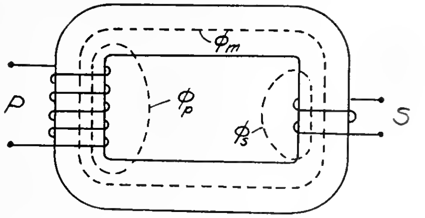


Fig. 1. The Transformer.

Fig. 1. shows the transformer diagrammatically. An impressed e.m.f. at the terminals of the primary P will produce a current through the primary coil. This will set up a magnetic field; a part of the flux will take the path ϕ_m and be interlinked with the secondary S, and a part will take the shorter path ϕ_p. The variation of the flux along ϕ_m, due to the variation of the primary current, will induce an e.m.f. in the secondary coil, and a current will flow if the secondary circuit is closed. This current will also produce magnetic flux, a part also taking the path ϕ_m and a smaller part the path ϕ_s. The flux threading the core and designated by ϕ_m is therefore the resultant of the fluxes produced by the magnetomotive forces of both primary and secondary coils. Since this flux is interlinked with both circuits it is the flux of mutual induction, while the fluxes ϕ_p and ϕ_s, being interlinked with one circuit only, constitute the self induction of primary and secondary, respectively.

The e.m.f. induced by the flux ϕ_m must be the same per turn; hence the e.m.f's. induced in primary and secondary coils must be to each other in the ratio of their respective turns. The primary induced e.m.f. plus the "drop" in the primary coil must equal the impressed e.m.f. at the primary terminals. The secondary induced e.m.f. less the drop in the secondary coils must equal the e.m.f. at the secondary terminals.

In the following discussion, whenever the unqualified terms current, e.m.f., magnetomotive force, etc., are used, the maximum values will be understood.

In Fig. 2 let the vector O — ϕ_m represent the phase and maximum value of the flux of mutual induction represented by ϕ_m in Fig. 1. Then the primary and secondary induced e.m.f. are represented by the vectors O — e_p and O — e_s, their phase being one-quarter of a period behind the flux ϕ_m and their lengths being in proportion to the ratio of the respective turns in primary and secondary coils.

Let O — a represent the phase of the resultant magnetomotive force, which leads the flux of mutual induction by the time value of the angle a O ϕ_m because of hysteresis.

Let O — I_s represent the phase and magnitude of the secondary current lagging behind the induced secondary e.m.f. by the time value of the angle e_s O I_s. Since magnetomotive force must be in phase with the current producing it, the secondary magnetomotive force is represented by O — $I_s N_s$.

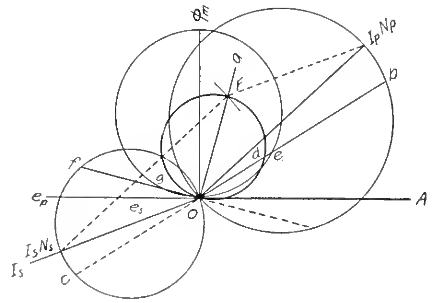


Fig. 2. Magnetomotive Forces.

If the magnitude of the primary magnetomotive force is known its phase may be determined as follows: With $I_s N_s$ as a center and radius equal to the primary magnetomotive force, draw an arc intersecting O — a. From the point of intersection F draw a line parallel to O — $I_s N_s$ and complete the parallelogram. The vector O — $I_p N_p$, then, represents the phase and maximum value of the primary magnetomotive force, for O — F is the resultant of O — $I_s N_s$ and O — $I_p N_p$.

The graphs of the magnetomotive forces and the flux of mutual induction may now be obtained by circumscribing the circles about the respective vectors representing the magnitudes and phases of the maximum values. The instantaneous relationships may then be investigated.

At the time corresponding to the vector O — b, the primary magnetomotive force equals O — b and is positive, the secondary magnetomotive force equals O — c and is negative, the resultant magnetomotive force equals O — d and is positive, and the flux of mutual induction equals O — e. At the time corresponding to the vector O — f, the primary magnetomotive force is equal and opposed to the secondary magnetomotive force, the resultant magnetomotive force is zero, but the flux is O — g. Although no magnetomotive force is active, a flux exists due to the hysteresis of the transformer.

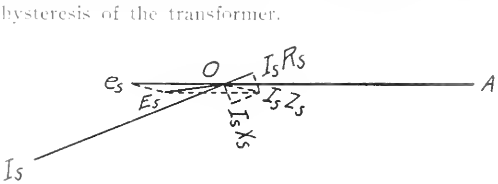


Fig. 3 Secondary E.m.f.

It is seen that, in general, the primary magnetomotive force opposes the secondary. This is the key to the self-regulating action of the constant potential transformer.

In Fig. 3 the vectors O — I_s and O — e_s are reproduced from Fig. 2. O — $I_s R_s$ represents the phase

and magnitude of the counter e.m.f. of resistance of the secondary coils, one half-period behind the secondary current. $O - I_s X_s$ represents the phase and magnitude of the e.m.f. of self induction in the secondary coils due to the flux ϕ_s in Fig. 1. The phase and magnitude of the resultant e.m.f. of impedance, $O - I_s Z_s$, is found by drawing the parallelogram.

The e.m.f. at the terminals of the secondary must be the resultant of the induced e.m.f. and the e.m.f. due to the impedance of the secondary coils. The phase and magnitude of the e.m.f. at the secondary terminals is therefore $O - E_s$, being the vector sum of $O - e_s$ and $O - I_s Z_s$.

It is seen that the e.m.f. at the secondary terminals is less than the e.m.f. induced in the secondary coils, and that this difference becomes less if the internal resistance and reactance of the secondary coils are decreased. It is also seen that the greater the lag of the secondary current behind the secondary induced e.m.f., the greater is the drop in the secondary coil.

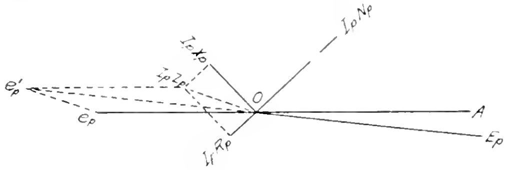


Fig. 4. Primary E.m.f.

In Fig. 4 the primary e.m.f. is calculated. The vectors $O - I_p X_p$ and $O - e_p$ are reproduced from Fig. 2. $O - I_p R_p$ represents the counter e.m.f. of internal primary resistance, $O - I_p X_p$ represents the internal primary reactance due to the flux ϕ_p in Fig. 1. $O - I_p Z_p$ is the resultant e.m.f. of internal primary impedance found by combining the components $O - I_p R_p$ and $O - I_p X_p$. The total counter e.m.f. at the terminals of the primary must equal the vector sum of the induced e.m.f. and the e.m.f. of internal impedance, and is represented by $O - e'_p$. Since the impressed e.m.f. must be equal and opposed to the total counter e.m.f., the phase and maximum value of the impressed e.m.f. is represented by $O - E_p$, equal to $O - e'_p$ and displaced from it by a half-period.

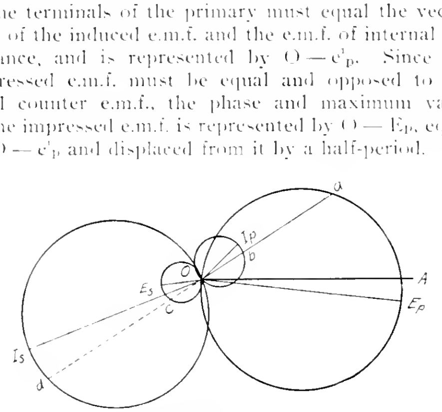


Fig. 5. Primary and Secondary E.m.f. and Currents.

Fig. 5 shows the graphs of the primary and secondary currents, the primary impressed e.m.f., and the e.m.f at the secondary terminals obtained by circumscribing circles about the vectorial diameters representing the phases and magnitudes of the maximum values reproduced from the preceding diagrams. It is seen that the secondary current lags behind the e.m.f. at the secondary terminals by the time value of the angle $E_s O I_s$, and that the primary current lags behind the primary impressed e.m.f. by the time value of the angle $E_p O I_p$.

The values of the current and e.m.f. at any instant may be determined by drawing the corresponding vector and measuring the intercepts. At the time corresponding to the vector $O - a$, the primary e.m.f. equals $O - a$, the primary current equals $O - p$, the scondary e.m.f. equals $O - c$, and the secondary current equals $O - d$.

Fig. 5 also shows why there is a loss of capacity when the current and e.m.f. is not in phase. If the one lags behind the other, as in Fig. 5, the maximum value of the one does not occur at the same time as the maximum value of the other, hence the power output will be less for the same maximum (or effective) e.m.f. and current, since the summation of all instantaneous products e i d t, which equals the power, is a maximum when the current and e.m.f. are in phase, that is when the power factor equals unity.

Many other peculiarities of transformer action may be seen by collecting certain of the vectorial diameters and circumscribing the corresponding graphs.

WIRELESS TELEGRAPHY OVER DESERT.

Dr. H. L. Coffman of Palm Springs, Cal., is securing estimates on the cost of installing a series of wireless telegraph stations that are to cover the upper reaches of the Conchilla desert. The plan is to establish at least five stations. One is to be located at Banning, in San Gregorio Pass. The second will be at Seven Palms on the north side of the desert. The third will be at the Palm Springs agua caliente. The fourth relay will be at Indian Wells to the south, while the fifth will be erected at Indio.

ENGINEERS' LICENSES AT LOS ANGELES.

Mayor Alexander of Los Angeles has signed the ordinance making a new percentage classifications of stationary engineer's licenses. Those of the first class may operate boilers of any power; those of the second class are limited to 500 horsepower, and those of the third class any of 100 horsepower or less. The measure had the opposition of some of the unions, but was supported by the National Association of Stationary Engineers.

POLES SHIPPED AS LUMBER.

Rates on poles and piling from Oregon points to California cities over the Southern Pacific have been declared unreasonable by the Interstate Commerce Commission to the extent that the rates exceed lumber rates between the same points. In a case decided this week, the California Pole & Piling Company of San Francisco was the principal complainant. The road charged a rate of $6 per ton form Oregon points to San Francisco. The commission decided that the lumber rate of $5 should have been charged and awarded reparation of $1376.27, with interest, to the San Francisco firm.

TURBINE LOSSES AND THEIR STUDY.[1]

BY ROBERT SIBLEY.

In a former lecture we found that there are four losses in the operation of the steam turbine; 1. Friction loss in the nozzle or other stationary guiding device. 2. Inefficient angles formed by blades of the stationary and rotating parts. 3. Friction loss due to the flow of steam through the rotating parts. 4. Mechanical losses such as friction in journals and bearings, windage and the like.

Now let us see how these different quantities may be computed and to what extent they may be obviated in the design and operation of the turbine. We saw in the first lecture on the steam turbine that the velocity of the steam emerging from the nozzle is computed by the formula $v = 223.84 \sqrt{H_1 - H_2}$, in which v is the velocity in feet per second, and H_1 and H_2 the respective total heats of the steam before entering and after leaving the nozzle. It is found in practice that about 10 per cent of the energy, $(H_1 - H_2)$, is lost in friction as the steam passes over the stationary portion, consequently all of the original energy is not available for producing the velocity of the emerging steam.

Let us suppose that m parts of unit energy are lost in this friction, then $(1 - m)$ parts are left for the production of kinetic energy and since there are $(H_1 - H_2)$ units of heat in all, we have $(1 - m)(H_1 - H_2)$ units for the total production of velocity in the steam nozzle. Hence to speak more correctly, $v = 223.84 \sqrt{(1 - m)(H_1 - H_2)}$. If this quantity m has a value of 0.1, we find at once by substituting in this equation that the velocity becomes $v = 223.84 \sqrt{.9\,(H_1 - H_2)}$ $\therefore v = 212.42 \sqrt{H_1 - H_2}$. This, then, gives a more accurate formula for computation in the steam turbine and constitutes the method of computing velocities when the friction loss in the nozzle is definitely known.

A most useful diagram for handling computations of turbine design, and for determining the quality of the steam in the various states of expansion in the steam turbine is that shown in Fig. 1. Such a diagram is known as the Mollier chart and is worked out on an elaborate scale in the tables and diagrams of Marks and Davis. Let us for a moment examine the extreme usefulness of this chart. We have already found definite formulas for computing the velocity of steam in the nozzle of the steam turbine. In the diagram shown in Fig. 1, entropy of steam is plotted as horizontal lines and the total heat of the steam as vertical lines, while on the diagram itself are seen lines extending upwardly to the right which are those of equal pressure, while those slanting downward to the right are those of equal steam quality.

Let us suppose that we have steam in a turbine operating under 180 lb. absolute pressure and that it exhausts into the condenser at 0.75 lb. absolute. Assuming that the steam is superheated 100 degrees F., let us see if we can determine the condition of the steam when it enters the condenser. The point A on the diagram will be seen to represent steam at 180 degrees pressure and 100 degrees superheat. Looking vertically downward to the point D we come to the line representing 0.75 lb. absolute. We read at once that the steam has a quality of 79.8 per cent. We also see that the total heat of superheated steam at A is 1255 B.t.u., while that at D is 892 B.t.u. Hence the heat drop is 363 B.t.u.

We come now to the most important question of design in the steam turbine, which is a study of the proper relationship of angles of the entering steam with the moving vanes and that of the emerging steam with the moving vanes.

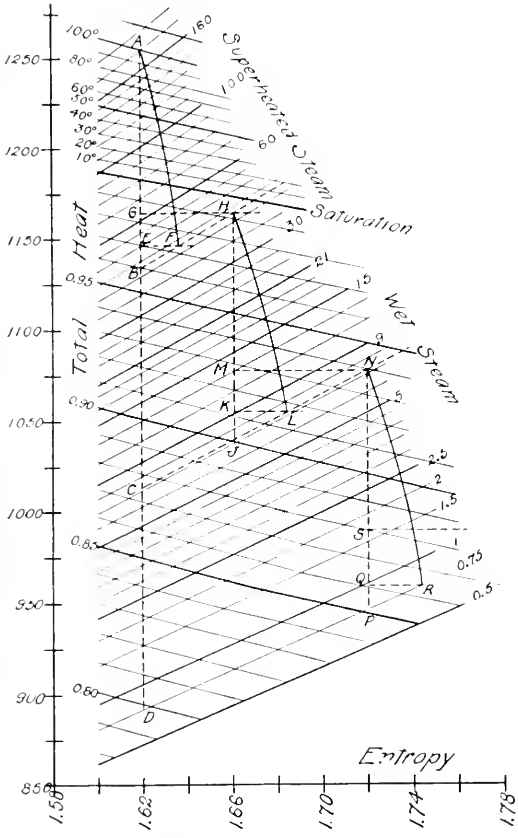


Fig. 1. The Mollier Chart or Heat-Entropy Diagram.

Let us consider an analogy for a moment. A "hold-up" fires at the engineer of an express train a bullet which travels at the rate of 60 miles an hour. The express train is also traveling at the rate of 60 miles an hour and is moving directly away from the rifle muzzle. The bullet is unable to overtake the engineer, consequently he is unharmed. If now the "hold-up" is traveling on the rear of the train and fires his shot, with an accurate aim, his shot is fatal to the engineer. The lesson to be learned from this example is the extreme care necessary in computation involving relative and absolute velocities. We may not all have our lives saved by improper velocity calculations of a "hold-up," but we shall see that it has a most important bearing in steam turbine design.

[1]This article comprises the Twenty-Second Lecture of a series appearing in these columns entitled "Primer of Applied Thermodynamics."

In Fig. 2 the steam nozzle A is emitting steam at the high velocity v against the bucket E, which is moving to the left at the rate of u ft. per second. The entering steam, which has a velocity v ft. per second, makes an angle a (shown as 20 degrees in Fig. 3) with the direction in which the bucket E is moving, consequently the velocity v may decompose itself in two velocities when moving with the vane E in an amount equal to the velocity of the vane E, which is u ft. per second, the other moving relatively along the surface of the vane E with an amount equal to V ft. per second.

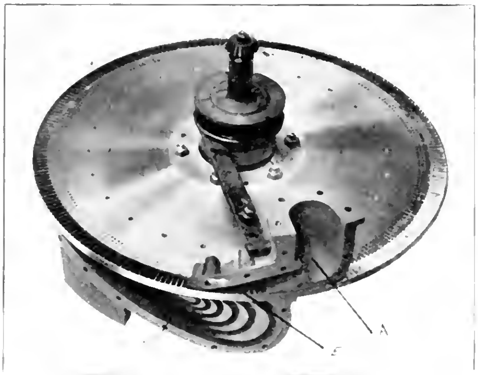


Fig. 2. The Steam Turbine Nozzle

In the study of elementary mechanics we find that this velocity v and its components u and V are related in a very simple and definite manner. Thus, looking at Fig. 3, let us draw to scale the velocity v, so that it makes the angle a with the moving vane or bucket E. The velocity u is laid off as shown in the direction in which the bucket E is moving. If now we complete the parallelogram BCDA as shown, the line AD represents in magnitude and direction the relative velocity V. In a word, if we were traveling on the vane or moving bucket E, the steam would appear to us as moving along the surface of the bucket in direction AD and equal to V ft. per second. Considering ourselves still traveling with the bucket E, the steam is forced to constantly change its direction of motion because of the curved surface of E, consequently it finally emerges from the vane at H, moving with a velocity with respect to the moving vane E of W ft. per second. It is evident that if nothing has happened to decrease the velocity of the steam as it moves along this vane, W will be equal in magnitude to V.

Assuming ourselves now, not as riding with the bucket E, but as looking at its movements as we stand nearby, let us see if we can find the absolute velocity of the emerging steam. Applying the rule just formulated from elementary mechanics, we see that the velocity of the emerging steam is made up of two components—that moving in the direction of the moving bucket E, which is u ft. per second, and that moving along the vane which is in magnitude W ft. per second. Hence the diagonal HG of the parallelogram HKGL represents the final absolute velocity in magnitude and direction and is as shown w ft. per second.

Years ago, Sir Isaac Newton announced to the world certain laws of motion which have become classics and which are regarded as the basis of the mathematics of engineering. One of these laws states "that to every action there is an equal and opposite reaction," and also "that a body in motion will continue in motion and a body at rest will continue at rest unless acted upon by some external force." Let us now apply these two simple laws and deduce at once the energy and power relationship in the turbine.

Looking again at Fig. 3, we see that the steam enters the moving bucket with a velocity of v ft. per second. This velocity makes an angle a with the moving vanes. The steam finally emerges from the moving vane, possessing a velocity of w ft. per second and making an angle b with the moving vane. Something then has happened to the moving steam in its journey through the rotating blades. In a word, a

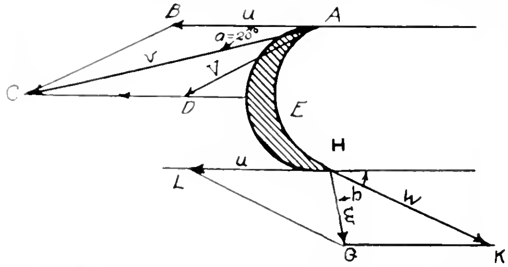


Fig. 3. The Velocity Components in Moving Blades.

force has been acting and this force is as stated by Newton, in proportion to the rate of change in this velocity. Since the component of force which goes toward useful work is in the direction of the moving bucket E, let us then find the rate of change this velocity has encountered in the direction of the moving bucket E. The steam entered with the velocity v making as we have seen an angle a with the moving vane, consequently (v cos a) is the component velocity of the entering steam in the direction of the moving vane. Since the steam leaves the moving vane with the velocity w ft. per second making the angle b with the moving vane E, the component of velocity of emerging steam in the direction of the moving vane E is (w cos b). Hence, if we subtract these two quantities we have the net change in velocity occurring every second in the direction of the moving vane. The force, then transmitted by the steam to the moving vane E, is proportional to (v cos a + w cos b). Mathematically expressed this is F = k (v cos a + w cos b), in which k is constant and in engineering practice this constant is the value of $\frac{1}{g}$, where g is usually taken as 32.2.

Hence, the force acting per pound of steam is

$$F = \left(\frac{v \cos a + w \cos b}{g}\right).$$

Since work is a product of a force times the distance through which this force acts, and since the distance is evidently u ft. per sec., therefore, the useful energy per pound of steam is

$$\frac{(v \cos a + w \cos b)\, u}{g}$$

The total amount of energy supplied per pound of steam is, as we have found $(H_1 - H_2)$ heat units or $778\,(H_1 - H_2)$ ft. lb. Consequently the efficiency E from steam to buckets is

$$E = \frac{u\,(v \cos a - w \cos b)}{778 \times 32.2\,(H_1 - H_2)}$$

or

$$E = \frac{u\,(v \cos a - w \cos b)}{25051.6\,(H_1 - H_2)}$$

Let us, however, consider for a moment the efficiency of the steam due to the angular arrangement of the blades. In other words, let us not use in the denominator, as taken above, the energy of the steam before it passes through the nozzles, but rather after it has passed through and is just on the point of beating against the moving blades. We have seen that the velocity of the steam emerging from the nozzles is v ft. per second, hence the energy possessed by this emerging steam is, from elementary mechanics, found to be $\frac{v^2}{2g}$. Consequently, the efficiency of the moving blades with respect to the energy emerging from the steam nozzle is

$$E = \frac{\dfrac{u\,(v \cos a - w \cos b)}{g}}{\dfrac{v^2}{2g}}$$

$$\therefore E = \frac{2u\,(v \cos a - w \cos b)}{v^2}$$

Let us now see under what conditions this efficiency may be made a maximum; in other words, under what angular velocity arrangement of the moving parts may we get the most energy from the steam. Looking at the equation just arrived at, we see at a glance that the expression $(v \cos a)$ becomes the largest possible when a is zero, for at this point the cos a is unity. This means for ideal conditions the nozzle should deliver all steam in the exact direction in which the buckets are moving, which is impractical, but by careful design the angle a is made as small as possible.

Again the expression $(w \cos b)$ becomes the lowest when it is equal to u, for at this point the steam would drop lifeless from the moving blade. This also is impracticable, but it indicates the end toward which proper design leads. Under the angular conditions above mentioned our expression for efficiency is

$$e = \frac{2u\,(v - u)}{v^2}$$

or

$$e = \frac{2}{v^2}\,(v - u)\,u.$$

It is now interesting to see what the speed of the moving vane should be with respect to the entering velocity of steam, in order to utilize the maximum energy of the steam. In elementary calculus we find that by putting the first derivative of e with respect to u equal to zero and solving for u we shall arrive at this ideal toward which we should work. Performing this operation we have

$$\frac{de}{du} = \frac{2}{v^2}\,(v - 2u).$$

Putting

$$\frac{de}{du} = 0,$$

we have

$$v - 2u = 0, \text{ or } u = \frac{v}{2}.$$

Consequently we deduce this most important law, that to absorb all of the energy from the entering steam the moving blade should rotate with a speed equal to exactly one-half that of the entering velocity of the steam.

Let us now consider for a moment the third loss met with in the operation of the steam turbine. This loss is, as we have seen, due to friction caused by the steam rushing over the moving blades and in practice is found to be from 5 to 20 per cent. We stated above that if there were no loss, the relative exit velocity W should be equal to the relative entrance velocity V, but since there is a loss and this loss is at an average of [illegible] per cent, we assume in design that W = [illegible] V. Taking advantage of all the angular relations now found and having given the boiler and exhaust conditions of the steam, we can proceed with the computation of the velocity relations in the turbine.

The fourth consideration being that of losses due to mechanical friction cannot be computed completely by theoretical means. The only way to accurately determine the loss due to the heat in the bearings and journals, and loss due to windage and other minor quantities is by careful tests performed after the turbine is completely designed.

Thermotwisters.

1. Steam is delivered to a turbine at [illegible] abs. with [illegible] F. superheat. The condenser operates at [illegible] abs. What is the energy possessed by each lb. of steam leaving the turbine nozzle assuming [illegible] loss in nozzle due to friction?

2. The nozzle makes an angle of [illegible] with the moving blades in the above problem and the steam leaves at an angle of [illegible]. Assuming five stages of expansion and that the blades move with a velocity of [illegible] ft. per sec., what is the steam to bucket efficiency?

3. What should pressure gauges read if inserted at each one of the above stages of expansion?

THE EFFECT OF GRAVITY.

The effect of the [illegible] upon the earth's attraction or gravity is the subject of an interesting report now in press, of an investigation by the Coast and Geodetic Survey of the Department of Commerce and Labor. It has been proved, as a result of investigations by the Survey of the deflections of the vertical and by similar investigations in other countries, that a condition of approximate equilibrium exists in the earth's crust as well as in its interior. By the earth's crust is meant the first hundred miles, more or less. The continents and mountain masses are not held up by the rigidity of the earth's crust, nor are the oceans thus maintained, but the land areas are floated by a defect of matter beneath them, and the ocean bottoms are depressed and held in place by an excess of matter beneath the ocean areas.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

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CONTENTS

Electric Energy for Frost Prevention

The successful campaign for frost prevention has passed through an interesting history. As early as 1895, Professor Alexander McAdie, head of the U. S. Weather Bureau at San Francisco became interested in the problem and to him is largely due the present remarkably high development in our knowledge along frost protective lines.

First came the coal bucket, which was lighted upon notification of the approach of frost by the U. S. Weather Bureau. Then the wet smudge of straw and manure was advocated to form a cloud or reflecting medium above the orchard in order to return back to earth the radiating heat rays, and thus conserve the heat in the air and soil immediately surrounding the orchard trees. Flooding with water followed with some success in protection from frost among the orange groves of Louisiana, but it had a detrimental effect in pushing forth the young shoots too early in the spring. Finally came, however, two more generally useful methods—the antifrost cover, an invention of Professor Alexander McAdie, and the oil heater. The former is a prepared paper, light in weight, and is easily thrown over the tree, thereby conserving its natural heat. The latter method, the oil heater, seems especially applicable to large trees. These oil-burning heaters are now in widespread use and have been successfully employed in raising the temperature 5 degrees, or even more at critical times, thus demonstrating their worth beyond question.

During the latter part of December of the year just closed, Southern California experienced a siege of cold weather. The period over which it lasted was record-breaking in many respects, yet those orchards which are being reared under careful and scientific management suffered but little. On another page, is told how the valuable crop of a lemon orchard of 225 acres near Santa Barbara was completely saved during this trying period for $15.75 per acre.

The data that have been collected show that the heat quantity necessary for protecting the tree and its crop is well within the financial possibility of electrical application, provided proper means can be devised to economically install the necessary apparatus. Seldom can we find an electrical load more ideally suited to the power plant than between the hours of one to seven o'clock in the morning. Indeed, the utilization of the "grave-yard" shift has long been the goal toward which the progressive power plant manager has turned his efforts.

Many different methods of electrical protection from frosts are being thought of and to a certain extent, experimented upon. The oil heater, though unquestioned now as to its accomplishing a successful protection, is a nuisance in the soot and foul gases formed. It would seem, then, that an electric process would be superior to any of our present methods, in ease of manipulation, in cleanliness, and possibly in range of control at critical times.

One orange grower during the frost of last Christmas spent $4700 for fuel oil. Here then is a great field of application for small electric heaters, or even small evaporating pans heated electrically and carefully placed so as to get a maximum heat application at the particular cold spot in the ranch. Indeed, it is reasonable to think that a movement of air—the greatest frost

preventative known—can be accomplished by electrically heating certain strata of the dead or cold air at proper points, thereby creating a chimney effect.

The whole field is new, and yet electrical application of heat in every respect would be so complete, so effective, so lucrative to the power plant owner, that it would seem of sufficient importance for an immediate systematic and detailed investigation.

Economy in Household Lamps

The layman, and quite frequently some of us who profess to know more or less about the electrical industry, frequently operate lamps not only at improper voltages, but also over a period exceeding the useful or economic life of the lamp.

Some years have passed since it was established that a slight increase in voltage causes the lamp to burn many times its natural brightness, though to its detriment, and, again, a slight reduction in the voltage causes it to be unduly lessened in light-giving qualities. The subject, then, of installing lamps of proper voltage has been pretty thoroughly covered, and cases, where improperly installed lamps are being used, are comparatively few.

The burning of lamps far beyond their useful period is, however, still the ruling sin in household economy. As long as a ray of light is given out, the lamp is held to its inefficient service, even though the consumer is unwittingly paying many times the price per actual candle power delivered that would be necessary in case a new lamp were installed.

Let us for the moment look briefly into the theory of the economic use of the lamp. It is admitted at the start that the more watts used, the more the cost of energy becomes. On the other hand, if a lamp costs a certain amount of money, say 70c, and if it is burned 1000 hours, the cost per hour is one-half that of a lamp burning but 500 hours, consequently we see that the longer a lamp is burned the smaller the lamp cost per hour. On the other hand, the longer the lamp is burned, the greater is the cost of energy. These two costs constitute the total cost of lamp service.

If now, we can find the place at which the sum of these two factors—the one continually diminishing, the other continually increasing—becomes a minimum, we have at once the proper time at which to discard the old lamp for the new. On another page in this issue will be found the results of an investigation in lamp economy. There will be found a graphical representation of the two curves above alluded to and, also, a third curve, entitled total cost of watts per candle. The point at which this curve approaches nearest to the horizontal line is evidently the smallest cost in watts per candle, hence the point of greatest economy.

The inefficient use of the lamp in the household is comparable to the wasteful use of water. The modern high class system of irrigating canals is designed to deliver practically all the water to the orchard. The inefficiency of the domestic irrigator has led to a waste of nearly 50 per cent of this water. In the modern domestic supply of electric power, the power company delivers its energy in a manner that obviates every possible loss. The consumer, ignorant or heedless of economic lamp efficiency, wastes fully 50 per cent of the energy for which he monthly pays. The broadcast agitation on the part of the lamp companies to educate the public in the economic use of lamps is highly commendable, and is resulting in thousands of happier, brightier, and yet more economically lighted American homes.

Oakland and Antioch Railway

The net-work of interurban railways in Southern California is largely responsible for the unprecedented growth in that section of our country. The Inland Empire, in and about Spokane, has built up a system of interurban railways, during recent years, which has brought to the world a second demonstration of the prosperity and development that follows the trail of the interurban.

The severe topography surrounding the bay cities of California has almost made it prohibitive in the past to make electric connection with the great valleys of the interior. Scarcely a day passes, however, that we do not read of some great reclamation project being put forth by private enterprise to reclaim the rich tule lands of the Sacramento and San Joaquin valleys.

The bay cities, comprising a population of three-quarters of a million inhabitants, portray in this fact alone, the necessity of having produce markets within easy and rapid reach. Not only, then, is the question of passenger traffic one to be considered in a pliable interurban system, but the enormous movement of fruit and produce from the interior valleys is a problem which must be solved by modern electrical tractive equipment.

It is not surprising, then, that the past few months have seen ample capital subscribed to push immediately to completion an electrical link between Oakland and the city of Sacramento, the heart of the valley of the same name. It is said that the Czar of Russia, in giving his expert opinion to a group of engineers as to the proper method of connecting two of his important cities, drew a straight line between them and ordered it built accordingly, irrespective of intervening canyons and mountain summits. The Coast Range skirting the suburbs of Oakland and Berkeley has hitherto been a barrier unsurmountable so far as a direct traffic link with the interior Contra Costa drainage is concerned. But now comes the Oakland & Antioch Railroad with its deep cuts, long tunnel, and heavy fills, and accomplishes with a substantial construction worthy that of a transcontinental railroad the piercing of this range and the interlinking of the interior subsidiary valleys hitherto long isolated from the nearby cities.

The combination car, 55 ft. in length, with four motors, each of 75 h.p., operated by two multiple control attachments, adds its word in speaking for the substantial construction and equipment being used.

The electric interurban has been known to enter a district where there dwelt but the sage brush and jack rabbit, and to leave in its trail in scarcely a year, a row of promising and prosperous hamlets. The three farmers sitting on the rail fence observing an electric train pass for the first time, are said to have consecutively exclaimed, "Thar she comes. Thar she goes. Whar?" Indeed, development follows the electric interurban so rapidly it is difficult to tell from "whar" it comes, and "whar" it goes. The thousands of prosperous communities throughout the West bear witness to the early growth and encouragement received from the busy traffic-giving electric interurban.

PERSONALS.

J. A. Herr of the sales corps of the Sprague Electric Works, is visiting the Pacific Northwest.

F. S. Pratt, vice-president of the Stone-Webster Management Association of Boston, was at Seattle last week.

C. J. Rhodin, hydraulic engineer with J. G. White & Co., is in Northern California on an engineering investigation.

John M. Klein, manager of Mathias Klein & Sons, Chicago, Ill., is making his annual trip to the Pacific Coast.

F. B. Gleason, manager of the Western Electric Company's branch, has returned to San Francisco after visiting Seattle.

J. W. White of the sales department of the Fort Wayne Electric Works, has returned to San Francisco from Los Angeles.

H. C. Goldrick, Pacific Coast manager for the Kellogg Telephone & Supply Company, spent the past week at Los Angeles.

R. S. Buck, of the firm of Sanderson & Porter, is making a tour of the San Joaquin Valley looking over the electrical engineering situation.

A. H. Babcock, chief engineer of the Southern Pacific Company's electric lines, has returned from an important business trip to New York.

Thomas Mirk, of the firm of Hunt, Mirk & Co., spent the past week at Los Angeles, and other Southern California cities, on engineering business.

Bertram M. Downs has resigned as vice-president and director of the Brookfield Glass Company, of New York, after 26 years' service with the company.

A. J. Bowie, Jr. has resigned as engineer in charge of the design of the San Francisco high pressure fire system to look after his private engineering interests.

C. B. Hurley, a contractor of Tacoma, who was for some years at the head of a gas company in that city, has been visiting San Francisco during the past week.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, is making an extended tour of the Hawaiian Islands, accompanied by Mrs. Addison.

H. G. McMillan, who is connected with the rock drill department of the Fort Wayne Electric Works, has returned to San Francisco from a Southern California tour.

M. M. Corbin, a special agent connected with the sales department of the General Electric Company, has returned to San Francisco after visiting the factory at Schenectady, N. Y.

Wallace W. Briggs, assistant sales manager of the Westinghouse Electric and Manufacturing Company, who recently returned to San Francisco from the factory, is now at Los Angeles.

Nesbet Latta, vice-president of the Wisconsin Gas Engine Company, is visiting the Pacific Coast, having spent the past two weeks at Los Angeles and now being expected at San Francisco.

J. A. Balch is superintendent of the Honolulu Telephone & Telegraph Company and also manager of a wireless telegraph station at Honolulu. He spent the past week at San Francisco.

F. V. Bennis, supervisor of the Western Electric Company, with headquarters at New York, who spent the past ten days at San Francisco, is leaving for the East via Los Angeles, after having visited all of the branch offices on the Pacific Coast.

J. S. Thornton, the former manager of the Sonora branch of the Sierra & San Francisco Power Company, is now at Raymond, Wash., looking after the electric railway and lighting interests recently acquired by Sanderson & Porter on Willapa Harbor and Grays Harbor.

Jesse P. Churchill, one of the principal owners of the California-Oregon Power Company, is at San Francisco on business connected with the closing of the contract for a large hydroelectric unit.

Frank H. Bostwick of Denver, general Western representative of the Wellman, Seaver, Morgan Company, waterwheel manufacturers, of Cleveland, Ohio, is at San Francisco on contract business.

G. M. Tripp, superintendent of the Victoria branch of the British Columbia Railway Company, has just completed an extensive inspection tour of California electric plants, accompanied by Mrs. Tripp.

A. J. Myers, district manager of the Wagner Electric Manufacturing Company, has returned to his San Francisco office after an absence of more than a month at St. Louis and in Southern California.

J. H. Wise, assistant general manager, J. P. Jollyman, engineer of electric construction, and H. C. Vensano, civil engineer, with the Pacific Gas & Electric Company, took business trips into the interior of the State during the past week.

W. W. S. Butler, who was erroneously mentioned in these columns last week as but recently assuming control of the Western States Gas & Electric Company's Stockton properties, has been vice-president, treasurer and general manager of the company since its inception.

A. A. Birch, who has been in Australia in the interests of the automatic telephone system used by the Home Telephone Company, has just arrived at San Francisco from Melbourne, in company with J. Hasketh, who is at the head of the Australian government telegraph and telephone service. He will make a study of the operation of automatic telephones in the exchanges of this country.

P. H. Herlihy, chief engineer of the steam plant in the basement of the new Hall of Justice, at San Francisco, was severely burned about the head last Monday by an explosion of gas, which, presumably, accumulated under the boilers and was ignited by a flare-back from one of the fire boxes. E. F. Bennett, the chief electrician, had a narrow escape from serious injury by the sheet of flame and the explosion, which destroyed a partition in the boiler room.

ELECTRICAL CONTRACTORS' NOTES.

New figures are being taken for the Sacramento Armory. The former figures were $7000 too high.

The Regents' Hotel on Sutter street, between Kearny and Montgomery, San Francisco, is also being refigured. At present it looks as though this building will go ahead. The electrical work will amount to about $18,000.

Bids will be called for by Architect B. McDougal for the Standard Oil Company's new building within a few days. This building will cost in the neighborhood of $500,000. An up-to-date light and power system has been planned which will run close to $20,000 in cost.

The California State Association of Electrical Contractors is distributing to all the architects throughout the State a copy of the standard symbols for wiring plans. Although these symbols have been out for about five years and have been adopted by the American Institute of Architects, there are many of the architects throughout the State that are not familiar with them.

R. E. Warren, an electrical contractor of San Jose, who is now connected with the California Electrical Construction Company of that city, was a recent San Francisco visitor.

The San Francisco district offices of the Nernst Lamp Company and the Pittsburg Electric Specialties Company, have been removed from 88 Second street to room 203, Aronson Building.

NEW YORK JOVIAN LUNCHEON CLUB.

The New York Jovians held their usual luncheon February 21st and were honored by Mr. Henry L. Doherty, president of the Henry L. Doherty Co., the well known bankers, as speaker of the day.

Mr. Doherty's subject was "The Wage Earner as an Investor," and he placed before the Jovians a number of interesting figures, showing what could be done along investing lines by the small wage earner, and from his figures demonstrated the benefit to the entire country, if it were made possible for the wage earner to become an investor in securities, which could combine the element of safety with a fair percentage of return.

There was among the public generally, he said, a fear that the accumulated wealth of the country would, in the course of time fall into the hands of a small group of individuals, but this fear need be groundless, if it were realized what a great power the small investor as a whole could become, were they educated to save and properly invest a small portion of their income. One interesting figure which he gave as an illustration was what could be done toward the accumlation of average wealth by individuals so that $24.75 yearly, properly invested would amount in 21 years, (or in the time of a man coming of age) to $1300, the average wealth of the individual of the country, and that this saving by a father for his son would on that son coming of age amount to sufficient so that the son would be in the class of those who are assumed to have the average of wealth.

Mr. Doherty spoke of his varied experience in the electrical industry and of his experience having taught him the feasibility of applying engineering ideas to finances, and that a part of his work in life was to assist as far as he could, in the education of the great masses of our public to the necessity of saving a certain portion of their income, so that the majority of the public would in time come to control, through its savings the great proportion of accumulated wealth.

After Mr. Doherty's interesting talk, Mr. Geo. W. Elliott announced that he was requested to announce that Mr. Thomas Comerford Martin, secretary of the National Electric Light Association, had been made an honorary member of the Rejuvenated Order of the Sons of Jove.

Philip S. Dodd, chairman of the ways and means committee of the Jovian Luncheon Club, reported that a meeting of the ways and means committee had been held at which it was decided that the present form of organization was most satisfactory, and that the New York Statesman, Frank E. Watts, had reported that there were sufficient funds left from the last Jovian rejuvenation to take care of the expense of mailing cards, invitations, etc., the only expense entailed at present, and that the club could be considered in good shape financially.

He reported that the ways and means committee desired to assist in every way the membership committee, and that particularly all that was necessary to the successful maintenance and growth of the organization, was that each member secure before the next rejuvenation, one or two more members for the Jovian Order, and that if this were done there would be sufficient funds available to carry the expenses of the organization for another six months or year.

NEW CATALOGUES.

Sprague Electric Fans are attractively described in Catalogue No. 325 from the Sprague Electric Works, in a 40-page booklet printed in blue and black with handsome cover.

Folder 4224 issued by the Westinghouse Electric & Manufacturing Company describes the Type B-3 mine suspension trolley wire clamp and illustrates its application by showing complete and sectional views.

The General Electric Company, supply department, has issued the first supplement to their general supply catalogue No. 4824..

Sprague Electric Works of the General Electric Company are sending out a handsomely illustrated catalog of installation of direct and alternating current motor equipments for newspaper plants.

"The Ethics of Wire Making" is the subject of a neat booklet from The Safety Insulated Wire & Cable Company, in which are told some little known facts about cable construction and insulation. A detailed description is given of the painstaking processes through which safety ruby core passes.

BOOK REVIEWS.

Ship Wiring and Fitting. An illustration manual. By T. M. Johnson. Size, 4 x 6½ inches; 77 pages; 47 illustrations; cloth binding. Published by D. Van Nostrand Co. of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, 75 cents.

Electricity plays an important role in the modern finish of the ocean-going ship. Effective lighting is important. To know how to accomplish not only effective lighting, but to securely and safely place the wiring on board ship is a problem unique in the electric wiring art. Iron and steel take the place of stone and bricks in material met with, while vibration, moisture and salt spray make necessary precautions different from those on land problems. This little booklet treats in a clear, concise manner all the problems of ship wiring on vessels of the size of those putting out from our Western ports and will unquestionably find a welcome place among our maritime electrical workers.

Arc Lamps and Accessory Apparatus. Electrical installation R. Geo. Davey A. M. I. E. E. Size 4x6½ inches; 190 pages; profusely illustrated; clear type; strong paper; durable cloth binding. Published by D. Van Nostrand Co., of New York and for sale by Technical Book Shop, 106 Rialto Bldg., San Francisco. Price one dollar.

The recent growing applications of electrical power supply in mill and factory make the advent of this little publication opportune in every respect. The book contains over a hundred illustrations of methods used in every phase of wiring connected with such installations as set forth in its title. The cross-sectional views shown in which wires are taken over head, underground, or beneath, the floors, are of practical application in every mill or factory. A very simple extension of the methods shown would apply to western mine wiring in many instances and thus is this booklet of much value in a field for which little published matter exists.

Short Course in Graphic Statics. For students of mechanical engineering. By William L. Catheart and J. Irvin Chaffee. Size 5x7½ inches; 183 pages; 58 illustrations; durable cloth binding. Published by D. Van Nostrand Company of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco, Cal. Price, $1.50.

The student of mechanical engineering often encounters problems properly falling under the heading of graphic statics. He at once turns to the standard treatises on this subject but only the deep researches of the civil engineer award him for his trouble. While it is true that the Warren girder for an overhead crane, the walking beam of an engine fall under this head the far more numerous problems encountered may be completely solved by the general applications of the force and equilibrium polyphase. The little treatise as titled above covers such problems as needed by the mechanical engineer and consequently it will be a welcome stranger for his book shelf. The authors, both of high standing in the society of naval architects and marine engineering, speak throughout its nine score pages, with the stamp of experience in matters they attempt to cover.

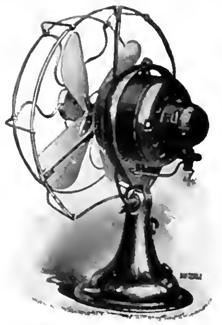
INDUSTRIAL

GENERAL ELECTRC FANS FOR 1912.

The General Electric line of fans for 1912 covers both desk and oscillating types in the 8, 12 and 16 in. sizes, direct current, and all frequencies alternating current. The standard voltages are carried in stock; odd voltages up to 250 volts may be furnished on order in any rating. The 8 in. fan is not furnished for frequencies above 60 cycles.

This line of motors follows in appearance and general features of construction the models of the preceding year. In many important details, however, decided improvements and refinements in design have been incorporated. The entire line of fans for 1912 has self-aligning ball-seated bearings with ample wick lubrication and definite oil deflectors and passages for the return of grease from the shaft to the grease cup. The attachment of the base plate has been much improved, as it is held on by one screw and the fibre insulating plate is reinforced by a thin steel plate. All sizes and frequencies of alternating current motors are of the induction type, free from moving contacts or brushes, furnished

8-in. A. C. Fan
(Desk and Bracket Type)



8-in. Oscillating Fan.
(Desk and Bracket Type)

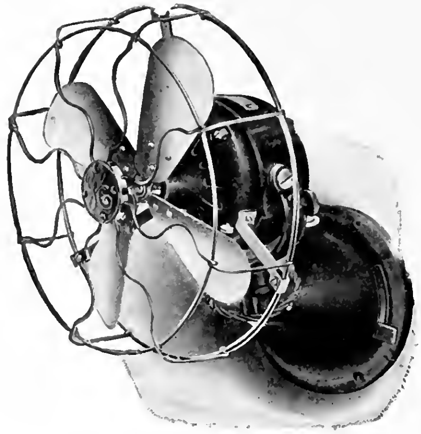
with a resistance reactance type of winding, having an extra resistance wound in one phase of the field and external reactance in another phase. This gives not only good starting torque, but when left in circuit gives an efficient winding and a flexible torque speed characteristic, permitting these motors to be controlled to a very low speed and still first-class starting characteristics to be obtained without any centrifugal switch or change in connection between starting and running conditions. This feature has been used in the main from two to three years, but only during the past year has the proportion of windings been worked out to perfection so as to give the very best results.

The oscillating motors have a positive oscillating mechanism with worm and gear speed reduction, using accurate die cast parts for the frame work. In the main features, there are duplicates of the mechanisms which gave unqualified success last season. Detail changes have been made, however, in the construction of the various bearings throughout on oscillating mechanism so that the dripping of oil or grease is either absolutely prevented, or, wherever this is impossible, a chamber is provided for catching and storing the drip. The 12 and 16 in. oscillators have two angles of oscillation and a simple gear change device which will give either the oscillating position, a locked position or a free position of the fan body. The 8 in. motor may be varied in width of oscillation from zero to the maximum.

The 12 in. 6-blade residence fans are especially designed for residence and hospital use where a quiet running fan giving a moderate breeze is desired. The 12 in. and 16 in. 4-blade fans deliver a stronger breeze than the residence fans and are for service in large offices, stores and public places. The motors are provided with switches which permit three speeds, thus providing regulation for all purposes.

SATISFACTORY TEST ON HIGH PRESSURE PUMPING PLANT.

The City Engineer of San Francisco reports that the quick steaming test of the boilers and the six-hour test of the entire mechanical equipment in the new pumping station at Second and Townsend streets have been satisfactorily completed. The contractor (Chas. C. Moore & Co. Inc., engineers) was required to guarantee that the efficiency of the boilers at rated capacity would not be less than 79 per cent; that they



12-in. 4-blade Fan (Desk or Bracket Type).

would be capable of carrying an overload of not less than 75 per cent continuously; that the fuel required to hold one boiler under steam would not exceed 5 per cent of the fuel required to operate that boiler at its rated capacity, and that steam could be raised on any boiler from cold water to 200 pounds steam pressure in thirty minutes. The efficiency of the boilers at rated capacity is 80.11 per cent.

One boiler was operated for ten hours at an overload of 82.6 per cent without injury to it or its setting. The oil used to hold one boiler under steam for twenty-four hours was 1.57 per cent of the quantity required to operate it at its rated capacity. Preliminary tests on the quick steaming capacity of one boiler showed that it could be fired in less than 25 minutes, and therefore in making the official test an attempt was made to fire an entire battery of boilers. Steam was raised in one boiler of the battery in 27 minutes and 32 seconds and in the other in 29 minutes and 51½ seconds.

IMPROVED CLOTH TAPE.

The Westinghouse Electric & Manufacturing Company has recently placed on the market a bias cut, treated cloth tape, which is made under a new process and for which some very satisfactory characteristics are claimed. It can be used as continuous tape, having a good tensile strength throughout its entire length, or may be divided into four-foot lengths by tearing or without the use of any cutting tool. Another advantageous feature is the absence of any sewed seams which, when present, have to be cut to make a neat job.

E. C. & M. MOTOR FIELD RHEOSTATS.

The Electric Controller & Manufacturing Company, Cleveland, Ohio., has recently placed on the market a new line of motor field rheostats for varying the speed of adjustable speed, shunt and compound direct current motors. The manufacturers claim the following features of design to be of important value. The construction is fire-proof throughout; the face carrying the arms and contacts is of the best quality Monson slate with beveled edges and oil finish, the resistance units consist of small cast iron grids insulated with asbestos and wound with resistance wires, these units being carried by the slate and fastened directly to the contacts; the resistance wire has an unusually low temperature coefficient so that the resistance of the rheostat—for any one setting—does not increase with heating and thereby alter the speed of the motor which it regulates, an ornamental dial plate carrying the words fast and slow, indicates at a glance which way to turn the rheostat handle to obtain the desired change in motor speed, by removing the four corner bolts the slate carrying the resistance contacts and arm, can be readily removed from the case; any one resistance unit may be removed and replaced without disturbing adjacent ones.

Improved Field Rheostat Control.

An extremely interesting and valuable adjunct to these rheostats is what has been designated the field rheostat relay. It is well known that a shunt or compound wound motor should be started from rest will full field strength and, in fact, if the shunt field is weakened to a large extent, it may be impossible to accelerate the motor, because of insufficient torque, prohibitive sparking at the commutator, or such a large volume of current that fuses and circuit breakers would be blown. It has, therefore, become the preferred practice, to return the rheostat handle to position of full field strength, every time the motor is started. The field rheostat relay has been developed to prevent starting the motor with a weakened field.

LARGER QUARTERS FOR THE H. W. JOHNS-MANVILLE COMPANY IN PITTSBURG.

The rapidly increasing demand in Pittsburg and vicinity for the asbestos, magnesia and other products of the H. W Johns-Mansville Company, has necessitated a move from their present location in Liberty avenue, above Ninth street, to larger quarters. After January 24th, 1912, the Pittsburgh branch of the H. W. Johns-Manville Company will therefore occupy the entire eight-story stone, reinforced concrete and steel building at the northeast corner of Wood street and First avenue, which has been leased by them for a term of years.

"VICTOR" INSULATOR SALES.

An item of interest regarding "Victor" insulators, showing the favor they are meeting with electrical engineers generally, is contained in an announcement received from the Locke Insulator Manufacturing Company of Victor, N. Y., to the effect that during the last few months they have closed contracts for their suspension types of transmission insulators as follows:

	Volts.
New England Power Co., Mass.	66,000
Mexican Northern Power Co., Mexico	110,000
Southern California Edison Co.	66,000
Puebla Tramway, Light & Power Co., Mexico	110,000
Cia Beneficiadora de Pozos, Mexico	60,000
Tri-City Railway and Light Co., Iowa	33,000

Pierson, Roeding & Co., of 118 New Montgomery street, San Francisco, with branch offices in Seattle, Portland and Los Angeles are the Pacific Coast agents for the "Victor" line of insulators.

GASOLINE ELECTRIC TOOL CAR.

The latest thing in railroading is the use of a gasoline electric tool car which is really a gasoline automobile running on the rails like a hand car and carrying an electric generator to operate the electric tools which have to a great extent superseded manual labor on the Rock Island Railroad. The motive power for the car is supplied by a 30 h.p. gasoline engine, and the electric power is furnished by a 6.5 kilowatt Crocker-Wheeler generator. The electric tools which it is designated to operate are two electric spike screwing machines, six electric drills, an electric saw for rails, and portable emery wheels. This is the equipment carried on each car.

If necessary this railroad automobile can pull additional cars or tenders to carry spikes, extra cable, or additional tools and men. From 1¾ to 2 seconds' time only is required to drive a spike with the spike screwing machine, as against 8 to 10 minutes per man driving one spike by hand in the old way. It has been found that soft wood ties can be utilized with the same degree of safety as hardwood by using screw spikes, and curve troubles are largely eliminated. The constant replacing of loosened drive spikes in ties is avoided, and there is consequently less rotting of ties caused by spike holes. Extra lengths of cable are carried with plug-in switches every twenty feet so that the electric tools can be used as far as a quarter of a mile from the car.

TRADE NOTES.

Hunt, Mirk & Co., agents for the Westinghouse Machine Company, have sold to the Los Angeles Gas & Electric Corporation an additional 5000-kw. Westinghouse-Parsons turbo generator. This steam turbine can be operated at either 50 or 60 cycles, and it is the third of the same make purchased for the power station on Alameda street, Los Angeles. The two units that have been installed already are of 3000 kw. and 4000 kw., respectively.

The General Electric Company reports a sale of a high-pressure steam turbine to the Stimson Mill Company of Seattle. The equipment is described as follows: One A. T. B. 4, 1563 k.v.a. (1250 kw.-8. pf.) 1800 r.p.m., 480 v., 3 phase, 60 cycle, horizontal, condensing Curtis turbine generating set, arranged for 150 lbs. steam pressure with 2 inches absolute back pressure. A Curtis turbine exciter set rated as C. C. 4, 75 kw., 3300 r.p.m., 125 v., non-condensing, is also included in the contract.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL. The Roseville Water Company; $200,000, shares $100 each, subscribed $300, by F. M. Ray, H. L. Simon and H. G. Luhisen.

SALINAS, CAL.—The Salinas Valley Water Company; $100,000, shares $100 each, subscribed $500, by C. S. Goodrich, J. T. Piggott, G. O'Connor and H. G. Hill, all of San Francisco.

SANTA BARBARA, CAL. The Santa Barbara and Suburban Railroad has filed articles of incorporation with a capital stock of $750,000, for the purpose of taking over the Santa Barbara Consolidated Railroad Company, under the proposed new franchise.

SAN DIEGO, CAL. Consumers in various sections of La Mesa depending on the Cuyamaca Water Company for their water, have decided to organize a company for the purpose of pumping a supply from the bed of the San Diego river east of Lakeside. It will be known as the Capitan Water Company, and have a capitalization of $90,000.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed by the Universal Electric & Gas Company, the stated purpose of which is to sell gas and electric current to the people of San Francisco and other California cities. The capital stock is fixed at $5,000,000, of which Rudolph Spreckels of San Francisco and Claus A. Spreckels of New York each own $2,499,850. The remainder of the stock is distributed into three $100 shares to J. H. Sanford and Frank Herrold of San Francisco and P. S. Scales of San Mateo.

TRANSMISSION.

SEATTLE, WASH.—Jenkins & Jones, Hinckley building, were awarded the contract at $5985 for the construction of the power house at Sedro-Woolley. Saunders & Lawton, Alaska building, are the architects.

CATHLAMET, WASH. W. J. Haycox and associates have been granted a twenty-five-year franchise by the City Council. The company will utilize the immense water power of the Elocoman River for generating electricity.

CALDWELL, IDAHO.—The Mainland interests and the Beaver River Power Company have secured identical franchises to deliver light and power in this city. It is thought the Mainlands will secure the W. R. Sebree plant.

WEED, CAL.—The California-Oregon Electric Light & Power Company has built a sub-station in Weed and is busy putting up the lines. It is using five wires and is about ready to turn on the power. The Weed Lumber Company will take about 600 h.p., but will not use it for more than a month yet.

SEATTLE, WASH.—A $12,000,000 mortgage was placed on record last week by the Old Colony Trust Company of Boston. The mortgage was given by the Puget Sound Traction, Light & Power Company, and covers all the real estate, personal property, rights, privileges, easements, licenses, franchises and other assets of the companies which are to be merged under the name of a $40,000,000 corporation. The mortgage was given for the purpose of enabling the company to issue two-year 5 per cent gold mortgage notes.

BUTTE, MONT.—The shareholders of the Butte Electric & Power Company has approved the deal for the purchase of the properties of the United Missouri River Power Company, which has been in the hands of reorganizers. The General Electric Company interests are back of the purchase which has had a bullish effect on the stock of the Butte company, the price having risen from 114 to 125. A big extension of the business of the company into a wide extent of territory about Butte is expected to result, the enlarged company giving the combined concerns almost double the capacity of the old.

SPOKANE, Wash.—The Lewis County Power Co. has been formed in Idaho by A. Welch and R. B. Montague of Portland, Ore., to develop 125,000 horsepower on the Salmon River, the plant, installation and transmission lines, representing an investment of $3,000,000. Construction work is to begin within 90 days and pushed to completion. The filings made at Nez Perce, county seat of Lewis County, on February 23, show the power sites acquired is the same as was located by the Lewiston & Southern Electric Railway Company several years ago, when it was planned to build an electric road from Lewiston to Grangeville. The driving of a 4,000-foot tunnel through a narrow ridge will provide a fall of 200 feet and empties the water again in the river at a point about seven miles below the point of intake. The initial plans provide for the driving of a tunnel through the ridge that will carry sufficient power to develop 40,000 horsepower at the beginning and the further development will be secured by the driving of a second tunnel or the enlargement of the first one. The completion of the plans will develop the 125,000 horsepower at a cost of $24 per horsepower, these estimates providing for the construction of the 200-foot dam across Salmon River at the point of intake, the driving of the necessary tunnels, the installation of the electrical equipment and the construction of the transmission lines. Mr. Welch and associates became interested in the central Idaho country a year ago, when the Nez Perce Power & Light Company was acquired. Transmission lines have since been extended to Ilo, Vollmer and Kamiah and representatives of the company have investigated every possible site on the Clearwater, Salmon and Snake rivers with a view of locating the big plant promised at the time the investment was first made.

TRANSPORTATION.

SPOKANE, WASH.—The Inland Traction Company will build two miles of road from Millwood to Irvin this spring.

BOZEMAN, MONT.—Preliminary surveys for an electric line from the mouth of Dry Creek to Bozeman are being made.

ROUNDUP, MONT.—The citizens have subscribed $11,000 toward construction of electric line from here to the coal camps.

BELLINGHAM, WASH.—The Bellingham-Skagit Company has obtained a franchise for 50 years to use streets here for its interuban line.

OLYMPIA, WASH.—The Olympia Terminal Railroad will soon start building to Tumwater, having secured a franchise from the latter city.

SEATTLE, WASH.—R. S. Terhune, president of Seattle Electric Company, states that the construction work on their line from Factoria to Issaquah will begin by April 1st.

WENATCHEE, WASH.—The Wenatchee Valley Railway & Power Company is asking a franchise to operate a suburban road. If it gets the franchise work will start in 90 days.

OAKLAND, CAL.—The new Southern Pacific Eighteenth street electric system, connecting the Fourteenth street terminus of the narrow gauge line with the main line at the Sixteenth street depot and thence to the mole, will be completed and ready for operation within two weeks according to officials of that company.

CALDWELL, IDAHO.—The electric line between here and Nampa is being built. The extension from the lower dam to Snake river is being surveyed. This line will tap the Gem irrigation project.

SANTA CLARA, CAL.—The Peninsular Railway Company has been granted a franchise for a period of 50 years to construct, operate and maintain a standard gauge electric railroad in this town.

RICHMOND, CAL.—H. C. Cutting has presented a petition to the City Council asking for a petition for a street car franchise the entire length of Cutting Boulevard, with branches to other sections.

VANCOUVER, WASH.—The Washington-Oregon Corporation has secured a franchise from the government to build its trolley line through the barrack gronnds. The line will be part of the line from Vancouver to Puget Sound.

SAN FRANCISCO, CAL.—Two more blocks of the Geary street railway municipal bonds, aggregating $70,000, have been disposed of by Treasurer J. E. McDougald, leaving but $143,000 worth in the hands of the treasurer out of the original $400,000 issue. The Federal Trust Company and the Bank of Italy were the purchasers, the transaction being made for clients.

SPOKANE, WASH.—Contracts will be let within 30 days for the construction of 63 miles of electric railway for the Oregon and Southern Railway Company, according to an announcement made by the officers of the company. The company plans to build 181 miles of railroad in Oregon between Ashland, Roseburg and Marshfield. It is declared that surveys and profile maps are already complete. The contract, according to the announcement, calls for completion of the first 63 miles of road by Dec. 1.

SACRAMENTO, CAL.—The Central California Traction Company and the Northern Electric Company are entering into an agreement for the establishment of a joint freight agency. The hearquarters will be in the Northern Electric freight office on M street, between Second and Third, near the west approach to the new electric bridge. The traction people will maintain their freight headquarters on X street for the purpose of handling carload lots, but smaller shipments of freight will be handled through the Northern Electric depot.

RICHMOND, CAL.—The Southern Pacific Company has decided upon the electrification of its lines from Berkeley to Richmond and from San Leandro through Haywards to Niles. According to the estimates made by the S. P. engineers, the work of electrification between Berkeley and Richmond can be completed this year; that between San Leandro and Niles by next spring. Train service between these points is to be doubled and the time will be practically cut in two. The present plans for the work on the Berkeley-Richmond and San Leandro lines call for the beginning of activities within the next sixty days. The Berkeley-Richmond work will be started first. The electrification of the line from Melrose to San Leandro is now nearing completion and just as soon as it is finished work on the extension of the electrical work on from San Leandro down through Decoto into Niles will be instituted. The Oakland-Berkeley lines are already electrified, and it is the plan of the railroad company to have through electric trains between Oakland and Richmond in operation by November at the very latest.

SAN FRANCISCO, CAL.—The Supervisors' public utilities committee has postponed action two weeks on Bancroft's proposal that the United Railroads be directed to route its Sutter street cars down the inner Market street tracks to the ferry. Chairman Vogelsang says that the committee and the United Railroads are considering an adjustment of differences. The company will abandon the injunction proceedings which have for so long prevented the construction of the roadbed on Geary street beyond Thirty-third avenue, and will take no steps of this kind to interfere with the city's road either on lower Market street or elsewhere. When cross-town feeders shall come to be planned for the municipal road the big private corporation is also to see to it that no impediments are raised. In return for this, the company wants leave to run its Sutter street cars to the ferries on the outer tracks on Market street, using the same jointly with the city's Geary street line. As the Sutter street franchise proper does not expire until 1929 the agreement in question will mean a virtual extension of the lapsed Market street privilege for 17 years.

ILLUMINATION.

OXNARD, CAL.—The municipal light and water bond question will come up before the Oxnard voters on April 5.

VALLEJO, CAL.—An ordinance fixing electric light rates at 10c per 1000 watts, with a 20 per cent discount if paid before the 15th of the month has been adopted.

PENDLETON, ORE.—The City Council is investigating a power site for a municipality owned electric plant. The site being considered is on the Walla Walla River a short distance below Freewater.

RIALTO, CAL.—Sealed bids will be received up to April 2d for a franchise granting the right to construct and for a period of 50 years to maintain and operate power lines along the streets and thoroughfares of this city.

DALLAS, ORE.—Prospects for the establishment of a factory in Dallas for the manufacture of an improved form of incandescent electric light socket are extremely favorable, according to C. W. Minnich, manager of the newly organized Adjustable Electric Socket Company of this city.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has applied for a 40-year franchise to erect and lay poles and wires for transmitting electric light, heat and power on public highways in the county of Kern. Sealed bids will be received for the sale of said franchise up to March 22.

SAN JOSE, CAL.—A construction crew of 100 men are at work installing a trunk line for the Sierra and San Francisco Power Company into San Jose, where agents have been busy for several weeks signing contracts for light and power. W. L. McKinley, local agent for the concern, says that he will be in a position to serve patrons here within 90 days.

NAPA, CAL.—The City Council has awarded to the Pacific Gas & Electric Company the contract to light the streets of Napa from March 1, 1912, to September 1, 1912, it being the only bidder. The Great Western Power Company was awarded the contract for one year after September 1, its bid being in some respects one-half that of the Pacific Gas & Electric Company.

SANTA ROSA, CAL.—The bid of the Great Western Power Company to furnish light and pump water for the municipal water works under a five-year contract at $1150 per month has been accepted by the City Council. The contract is effective July 1. The Pacific Gas & Electric Company has been lighting the city for 15 years. Its bid for the new contract was $1370 per month for a five-year term.

PORTLAND, ORE.—Plans for the establishment of a big gas and fuel manufacturing plant near the Government moorings, about one mile above Linnton, are under way by the Portland Gas & Coke Company. The removal of the plant to the new site will require the laying of several miles of main gas conduits. The distributing plants on both the East Side and West Sides will not be affected by the removal of the main plant outside of the city limits.

OAKLAND, CAL.—The following is the report filed with the City Council by the Pacific Gas & Electric Company: Receipts—gas sales, $1,025,181.79; electric sales, $1,032,089.89; total, $2,057,271.68. Costs—operation, gas plant, $628,098.16; electric plant, $832,465.91; total, $1,460,564.07; profit on gas and electric sales, $596,707.61; other net profits, $14,245.28; total net profit, $610,952.89. Value of assets used in company's business in furnishing gas and electricity to the city of Oakland and its inhabitants: Gas plant valuation, Dec. 31, 1911, $3,998,951; electric plant, Dec. 31, $3,196,483; total plant valuation, $7,195,434; stores and supplies, $186,305.16; accounts receivable, less customers' advance payments, $93,-590.58; petty cash, $3000; total $7,478,329.72.

OLYMPIA, WASH.—Sweeping charges are filed against the public service corporations of Pasco by J. H. Sylvester, mayor, in a complaint entered with the Public Service Commission. The Pacific Power & Light Company and the Twin City Telephone Company are made defendants, and it is charged that the rates for municipal light and water are exorbitant; that the company has refused to install a modern system in place of the old arc lights, as provided in the franchise; that the water system is inadequate, no pressure being available for fire fighting, and that the water is likely to cause contagion because of impure matter. The complaint cites that the telephone system, its station facilities and instruments are inadequate for the city.

TELEPHONE AND TELEGRAPH.

KAMIAH, IDAHO.—The Pacific Telephone & Telegraph Company has secured a franchise to operate in Kamiah.

CHEHALIS, WASH.—A telephone franchise has been given E. E. Coons and W. T. Justice for the Highland valley line.

PORTLAND, ORE.—The Pacific Telephone & Telegraph Company is ready to commence construction of a 14 story fireproof building to cost $500,000 at Seventh and Oak streets.

SEDRO-WOOLEY, WASH.—The Pacific Telephone & Telegraph Company is building a line from here to connect with the main line at Lawrence. They will also build a line south to Arlington.

SEATTLE, WASH.—Complete absorption of the Independent Telephone Company by the Pacific Telephone & Telegraph Company has been announced by Vice-President and General Manager E. C. Bradley of the latter company. Operation under one system is to begin as soon as the physical construction work consolidating the two plants can be completed. The Pacific company agrees not to raise its present schedule of rates for a period of two years, pending an exhaustive investigation of the whole telephone situation. This arrangement is subject to the approval of the State Public Service Commission.

SEATTLE, WASH.—Within a few days the Postal Telegraph Company will have in operation a long-distance telephone circuit with Spokane, and plans are being made for a long distance circuit between Seattle and Portland. The Postal Company is entering into the telephone business extensively and all new telegraph wires are strung so that they can be used for simultaneous telegraphing and telephoning. V. V. Stevenson, division electrical engineer of the company, with headquarters in San Francisco, is now in the city awaiting the arrival of equipment required for the Seattle-Spokane telephone circuit, and says that it is due to arrive any day and immediately thereafter the line will be opened for use.

SALEM, ORE.—Through an agreement reached following a conference between Harrison Allen, representing the Pacific States Telephone & Telegraph Company, and Attorney General Crawford and State Treasurer Kay, that company will pay into the coffers of the State approximately $110,000 for gross earnings taxes up to 1910 and probably about $30,000 more for 1911. Under the agreement the State will remit penalties amounting to about $12,000 or $13,000, but stood pat to collect the interest, which is over twice as much as the penalties. The State Treasurer's office has not compiled the exact figures. This agreement is a tacit admission on the part of the telephone company that the gross earnings act, passed by the people at the general election in 1906, was not repealed by implication by the general tax code of 1907 or the law creating a State Board of Tax Commissioners in 1909, although it has been so considered by some attorneys. It is estimated that the decision in the United States Supreme Court against the telephone company will further mean annual taxes from these companies collectively over $100,000. The gross earnings law called for imposition of a tax of 2 per cent annually on the gross earnings of certain public service corporations.

WATERWORKS.

BUTTE FALLS, ORE.—The city has voted $10,000 in bonds for the construction of a first class gravity water system.

HERBER, CAL.—Owners of the new townsite of Herber are planning to install a domestic water system in the near future.

SANTA ANA, CAL.—The Board of Trustees will advertise at once for the construction of an auxiliary water system. A concrete reservoir and cast iron mains will be built.

SACRAMENTO, CAL.—A few more details of the project of the United Water & Power Company to supply the city with pure mountain water accumulated in a reservoir near Gold Run were supplied to the water committee of the City Trustees this week by James D. Stewart and Engineer W. P. Ireland, representing the water company. The company offers to pipe the water to Sacramento in two large lines of concrete pipes for $2,500,000, and place at the city's disposal from 20,000,000 to 100,000,000 gallons a day. A system of cross pipes between the main lines, a mile apart, is promised so that the water supply shall not be impeded in case of a break in the line.

The water will be stored near Gold Run and carried to a distributing reservoir at Roseville. A site will be furnished for the city of Sacramento to build a filtration plant near the reservoir. Double lines of 66-inch concrete pipes will carry the water to 12th street bridge and under the American River. All pipes will be underground. The water supply will be drawn from the filtration plant. The two proposals submitted by the water company were: The United Water & Power Company will construct the double pipe line and tunnels specified above, the pipes to be of reinforced concrete six inches thick and the tunnels to be lined with reinforced concrete 12 inches thick and will deliver to the city of Sacramento, said pipe line and tunnels, a site for filtration plant and a permanent right to any amount of water from 20,-000,000 gallons per 24 hours to 100,000,000 gallons per 24 hours, all for the sum of $2,500,000. The United Water & Power Company will construct the double pipe line and concrete lined tunnels specified above, the pipes to be constructed of riveted and dipped steel, and will deliver to the city of Sacramento, said pipe line and tunnels, a site for filtration plant and a permanent right to any amount of water from 20,000,000 gallons to 100,000,000 gallons per 24 hours, all for the sum of $3,000,000. All surveys, plans, engineering and construction work will be done by the United Water & Power Company, under the general supervision of the city engineer. If surveys are started this spring the entire work can be completed and the water will be available by July 1, 1914.

JOURNAL OF ELECTRICITY

POWER AND GAS

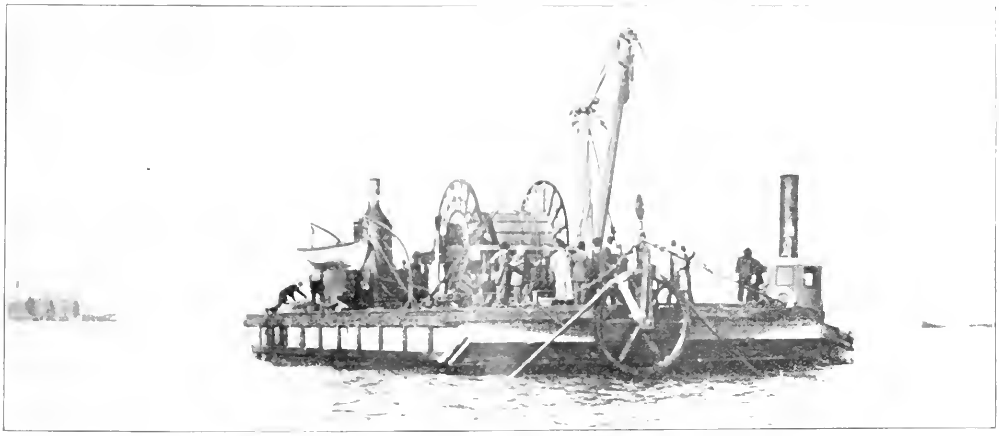
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, MARCH 16, 1912 | NUMBER 11

TRANS-BAY CABLE OF GREAT WESTERN POWER CO.[1]

BY SAMUEL E. NAPHTALY.

The problem of laying a submarine power cable across San Francisco Bay was first considered by the writer in 1902 and 1903, when connected with the San Francisco Gas & Electric Company. At that time the Standard Electric Company was endeavoring to deliver current into San Francisco over their transmission line along the peninsula from Mission San Jose. The fog and other conditions made the delivery so unsatisfactory that a solution in a submarine cable was considered. Not being able to arrange satisfactory terms, the possibility of this source of supply was dispensed with and not until 1905, after the purchase of the San Francisco Gas & Electric Company by the Pacific Gas & Electric Company, was the matter again taken up, the idea being to transmit power from the First and Grove Street Station in Oakland to Station C on Jessie street on the San Francisco side.



Laying Great Western Power Company's Cable Across San Francisco Bay

In the latter part of 1906 the subject was again revived and carried so far as to receive permission from the commandant at the Goat Island training station to land the cable on either side of Goat Island with the idea of carrying an overhead line across the island in close proximity to the present overhead telephone lines, but nothing more definite was done at that time.

The Great Western Power Company also gave some study to the problem during the early construction period of its plant in 1906-07.

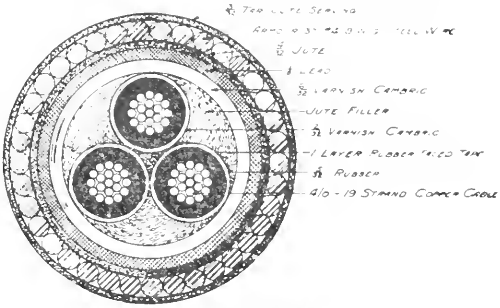
From time to time, however, in order to keep in touch with the development of the submarine cable, much discussion was had with the different manufacturers and many types and various schemes were proposed by them, some suggesting three single conductors in separate leads, others triple conductor, some steel and some copper armor. No reliable progress was made and the scheme was dropped until the year 1910 when the City Electric Company gave some attention to the problem with a view of delivering current to Oakland from its steam plant at North Beach.

The acquisition of the City Electric Company by the Great Western Power Company placed both concerns under one management and immediately the advantages of a connection between these two growing concerns became apparent. The City Electric Com-

[1] Paper presented before San Francisco Section, A. I. E. E., February 26, 1912.

pany, supplying a demand in San Francisco of approximately 13,500 kilowatts, needed an independent and reliable source of power. The Great Western Power Company, with its 40,000 kilowatt, modern hydroelectric development on the Feather River, needed the regulating advantages at this end of its 153 mile transmission line that the steam turbine plant of the City Electric Company afforded. These obvious advantages, together with the economics which the introduction of hydroelectric power would mean to the consolidated companies, were immediately apparent, and plans were started for the placing of a submarine cable under the waters of San Francisco Bay.

The general problem involved a selection of voltage and design of cable best suited to the conditions as they existed, the distributing potential of the Great Western Power Company in Oakland being 12,000 volts and of the City Electric Company in San Francisco—11,500 volts "Y," with grounded neutral.



Cable C[illegible]

By this time, all the cable manufacturers were eager to construct such a cable as would accomplish the end in view, but in considering the size, carrying capacity and final determination of voltage, all agreed that the limit of cable sizes was the maximum diameter that the armoring machines would take care of. The problem then was, considering maximum diameter, voltage, carrying capacity and cost, to select the most efficient cable. The use of a potential greater than 12,000 volts meant increased insulation and decreased radiating ability, and consequent decreased carrying capacity. For example, a 3 conductor, No. 2 cable for 22,000 volts (the same external diameter as No. 0000, the cable selected) figured on a maximum safe temperature of 150 degrees Fahrenheit would give 4150 k.v.a., while a 3 conductor, 0000 for 12,000 volts would give 6200 k.v.a. when submerged in 55 degree water. Consequently, a selection of the 3 conductor, 0000 cable for 12,000 volts working pressure of cable.

While the several manufacturers varied somewhat in their suggestions, from the all Para rubber unleaded, to a leaded, paper insulated cable, the consensus of opinion was a cable of the following specifications, which was finally ordered from the Standard Underground Cable Company:

Three conductor, 0000, B. & S. gauge, each conductor being made up of 19 soft drawn strands, concentrically stranded together. Conductivity not less than 98 per cent, according to Matthiessen's Standard. Conductors are tinned as a protection against vulcanizing compound. The insulation on individual conductors is: 1st, 5/32 in., 30 per cent Para rubber; 2d, One layer of rubber-faced tape over the rubber insulation, with 1/8 in. lap; 3d, 2/32 in. varnished cloth over the rubber tape. The separately insulated conductors are twisted together with a pitch of about 24 in. and a jute filler saturated with insulation compound is used to round out the conductors before the belt or outer jacket is applied. The outer insulation belt consists of 6/32 in. varnished cloth, making a total insulation between conductors of 14/32 in., and between conductors and sheath 13/32 in. The lead sheath is 1/8 in. in thickness and contains 2 per cent tin. Outside the lead sheath is a serving of 4/32 in. tarred jute and over this jute is an armor of 37 No. 4. B. W. G. galvanized steel wires with a pitch of about 24 in. Over the armor is a serving of 4/32 in. tarred jute with a lime and sand finish.

The cable was tested at the factory at a potential of 32,000 volts between conductors, and between conductors and lead sheath for a period of 30 minutes.

The diameter over all is 3.75 in. and the weight is 17½ lb. to the foot.

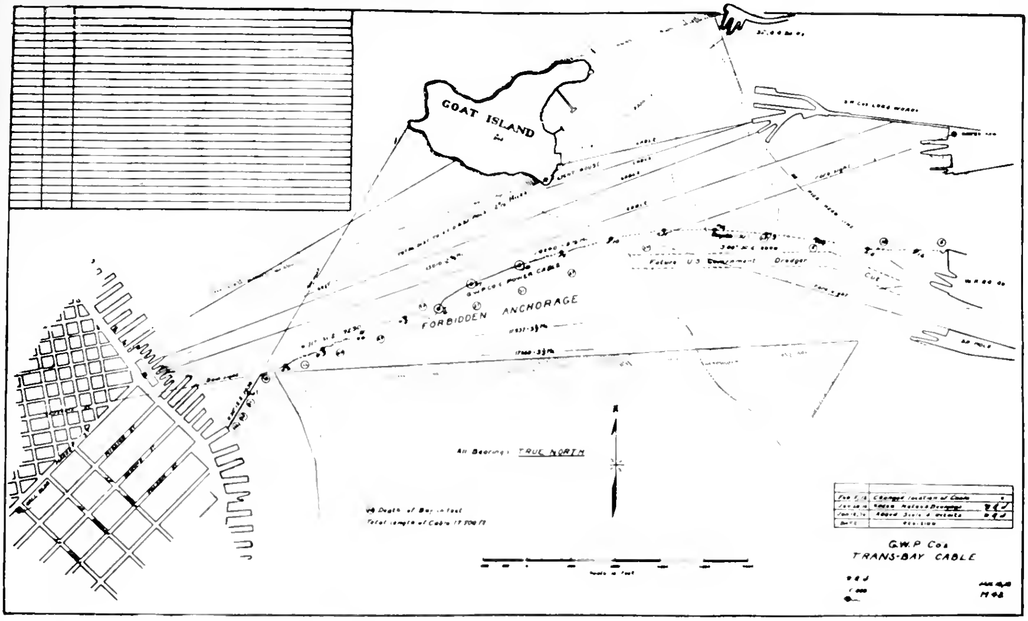
Permission was granted by the Secretary of War for the installation of this cable between the Western Pacific mole on the east bay side to the old army transport dock on the San Francisco side, over a certain route which is laid almost entirely in the forbidden anchorage and which bore to the north so as to avoid the new ship channel which is to be dredged westerly from Oakland Creek. The courses were mapped out and several runs were made over the arranged line so as to obtain fixed land marks where the courses were to be changed. These locations were plotted, to the end that definite position of cable was assured.

The length of cable as laid from the end of the transport dock, now known as Pier No. 12, to the Western Pacific mole, on the course laid, is 18,800 ft. To this is added 1000 ft. of triplex, 300,000 circular mill lead encased, double steel tape armored cable used for shore ends on both sides of the bay and leading along under the wharves out of the water to the overhead construction.

The manufacturer found it impossible to make the cable up in longer lengths than 1250 ft. The necessity of laying this cable in one piece and making all splices ashore was evident and the question of a suitable reel presented itself. Accordingly a horizontal reel was constructed with a steel shaft and arrangement of truss rods, having a minimum diameter of 11 ft., a length between heads of 26 ft., and a maximum diameter of winding space of 18 ft. To accommodate this reel and its weighty load it was necessary to have a barge of extraordinary stability and we fortunately succeeded in leasing a car float from the Santa Fe Railroad. This float is 37 ft. wide and 200 ft. long and is equipped with pilot house and rudders. The superimposed load was as follows: cable, 350,000 lb., reel 90,000 lb., boiler and engine (used for paying out) 20,000 lb.; total, 460,000 lb.

The run for laying of cable was made with a tug boat on each side of the barge and a third tug standing by for emergency use. The running speed varied from 200 to 500 ft. per minute.

The cable being laid in forbidden anchorage water, there is a minimum liability of interference from ship's



Map of Cable Crossings of San Francisco Bay.

anchors, and the depth of water varies along the course from a minimum of about 15 ft. to a maximum of 80 ft. The bottom of the bay on which the cable rests is sand or mud formation.

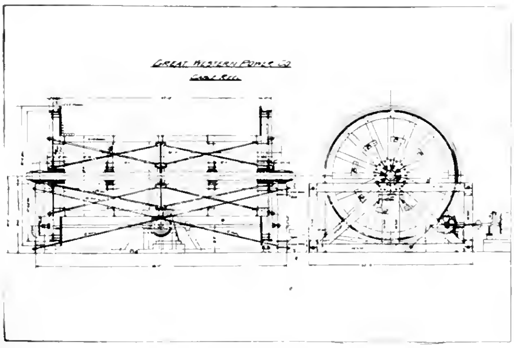
The operation of laying the cable was successfully accomplished on the afternoon of January 23d, 1912, although some difficulty was experienced in keeping the course on account of the incoming tide. The shore splices were made and the cable tested about midnight of the same day from the Oakland side.

In making the preliminary tests from the Oakland steam plant of the Great Western Power Company, after laying, a breakdown occurred at 11,500 volts. This immediately presented the interesting problem of locating, raising and repairing the fault, and no time was lost in getting ready for the work.

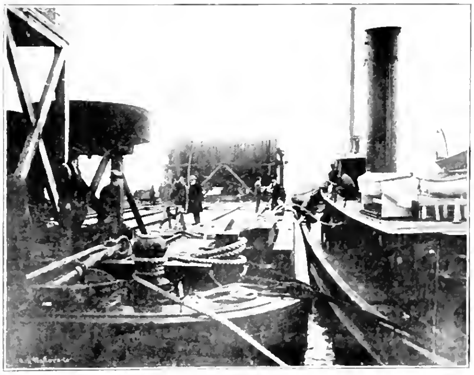
A Wheatstone bridge was first used in locating the trouble but the results were obviously unreliable and direct current at 250 volts was substituted by reading the current and potential drop.

The break was consequently located and the services of the cable repair outfit of the Pacific Telephone & Telegraph Company was enlisted to locate the cable and its fault. After towing the outfit approximately to the plotted location of the cable an anchor was cast overboard and the tug steamed away, slowly dragging the bottom, with the result that shortly the anchor was fouled and the cable hoisted out of the water and placed over a sheave 8 ft. in diameter which was suspended from the derrick on the barge. Once placed over the sheave, the barge was towed along in direction of the cable.

An alternating current of 100 amperes was maintained through the conductors and fault while underrunning and an exploring coil was used outside the armor. With current flowing, a distinct tone can be heard through a telephone receiver, the tone disappearing immediately on passing the fault. This method



Cable Reel.

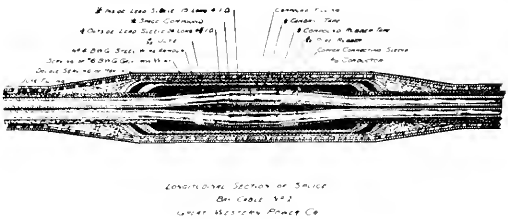


Cable Barge.

makes a definite and relatively quick means of locating trouble after the approximate location has been made by direct current tests for resistance. Accuracy of resistance tests is shown by results giving location within 5 ft. in 1500 and 100 ft. in case of the second fault, a distance of 7000 ft. from Pier No. 12.

Repairs were made in 24 hours' time, the cable thrown overboard and regular service commenced on January 29th. The two systems were paralleled and 1500 kilowatt hours per hour delivered in San Francisco the first day. This has been increased gradually to 3000 kilowatts which is about all that can be transferred without the aid of the regulating plant now on order.

The voltage compensating and regulating equipment for the Folsom street substation in San Francisco consists of a 575 k.v.a., 3-phase, auto transformer for boosting the potential from 9500 volts "Y" to 10,750 volts "Y" and a 690 k.v.a., 3-phase automatic, induction regulator with range of 1500 volts in either direction from 10,750.



Cable Splice

The auto transformer referred to above is also constructed with a winding suitable for raising the potential from 10,750 volts "Y" to 13,000 volts for use in feeding current back across the bay from San Francisco to Oakland in case of emergency.

The cable is protected on both ends by automatic oil switches and aluminum cell cable arresters.

On Feb. 20th at 6 p. m. the automatic switches on both ends of the cable tripped out and a test indicated a short on the cable. Upon testing by resistance method the fault was located 18,200 feet from the San Francisco end, or near the Western Pacific mole where the cable lays in 15 ft. of water at high tide. Immediately steps were again taken to find the trouble and after investigation it was found that the Western Pacific tug had lost its steerage way in low tide that evening and the propeller had cut the cable, causing an interruption.

The first two faults referred to above occurred at splices and were apparently due to slack armor, allowing a strain to come on the core during process of laying, resulting in a fracture of the lead sheath at the end of the sleeve.

The ease and certainty of locating and repairing faults lead us to consider the submarine cable a part of an ordinary underground system with the added advantage of water to put ont the fire.

The success of this novel undertaking is due to the personal interest manifested by the employes engaged on the work, and especially to Messrs. Hanscom and Beardsley for their untiring efforts and co-operation in personally directing every phase thereof.

DISCUSSION.

The Transbay Cable of the Great Western Power Company.

H. W. Crozier (Chairman): We are certainly obliged to Mr. Naphtaly for his paper and description of laying their cable across San Francisco Bay. The meeting is open for discussion. I think probably you would like to ask a few questions while they are fresh in your minds, if Mr. Naphtaly will be so good as to answer them.

Question: What is the capacity of the cable from shore to shore?

S. L. Naphtaly: We figured with a rise in temperature of 150 degrees, the maximum we can get through with unity power factor is about 6200 kw.

J. E. Woodbridge: Was that first fault described by the speaker at a joint or in the cable?

S. L. Naphtaly: All the faults were at joints. It seems to be due to the slacking of the armor. The armor was wound on the cable as tightly as it could be when it left the factory. In order to make the joints we had to pare the armor off a certain number of feet, and then the armor was wrapped across the joint with the same pitch, you might say, as it was on the run of the cable; but we found that the armor slacked back on the cable, and it was almost impossible to hold it. We did not appreciate the importance of that until we had the burn-out.

J. E. Woodbridge: Did the lead open?

S. L. Naphtaly: Yes. The strain came on the lead, and resulted in fracture of lead at the end of sleeve. We have found all this trouble at the joints; that is to say, at he end of the lead sleeve.

A. G. Jones: How did you get the moisture out of the joints after the burn out took place?

S. L. Naphtaly: The idea of impregnating the jute with insulating compound was to keep the moisture from running back, and we found little difficulty in cutting away sufficient cable to eliminate the moisture. The most we cut away was six feet, but we needed to take that up anyhow on account of the armor we had to get to replace the joint.

Mr. Clark: How much of a burn out was there in the first failure?

S. L. Naphtaly: In the trouble due to the tug there was a very decided burn, while at the splice there was but little evidence of burning.

Question: Why was it considered necessary to join the cable ashore before commencing the work of laying?

S. L. Naphtaly: We talked to everybody who had experience in this city and other places laying cable, and they all suggested the absolute necessity of joining the cable ashore on account of weather and tide conditions; but I am frank to say that the next cable we will join up on shipboard on account of the bending, and then it is a good deal easier to handle. You can go out there and anchor a barge, and get it overboard between tides; and even if you could not there is no difficulty on a calm day. If it is a rough day it may be more difficult, but not by any means impossible; in fact, it is the practical way to do it. Those are things we have to learn.

F. H. Varney: In anchoring there do you anchor the tug-boat or the barge?

S. L. Naphtaly: As I tried to bring out, the method of catching the cable is to drag with an anchor in about the right location and hoist the cable on the barge. When the cable is picked up, it anchors the barge—the cable holds it against tide or wind. I believe other cables have been picked up, but there seems to be no difficulty about it. I saw a scow pick up one the other day and throw it back, but we seem to have telephone communication just the same.

H. Y. Hall: Was the use of a cable with varnish cambric insulation only considered, and what would have been the increased carrying capacity as compared with that of the cable installed?

S. L. Naphtaly: We did not go into that matter, because none of the manufacturers recommended a full cambric cable. The General Electric Company recommended a full rubber cable first; and they gradually, in order to meet the specifications, pulled down to a combination of Para rubber and cambric; but my recollection is that nobody figured on a full cambric insulated cable.

N. W. Reed: When you removed the armor outside the iron wire how did you join the ends together?

S. L. Naphtaly: When the armor was removed?

N. W. Reed: Yes. How did you make the joint in the armor?

S. L. Naphtaly: That was made by serving with a seizing around the end where the length of armor got back to the original size of the cable. When it passed the joint and got over to the original size of the cable there was a seizing put on there, and the armor was bent back over the seizing, and then the whole armor that was wound around was wrapped circularly with No. 6 wire.

N. W. Reed: There was no joint at all on the No. 6 wire?

S. L. Naphtaly: No.

N. A. Eckart: In the case of cutting the lead sheath under the water what precautions were taken in drying out?

S. L. Naphtaly: We found, as I mentioned before, the worst place, I think, was something in the neighborhood of six feet more than the piece necessary to cut off to get the armor. The test we made for moisture was taking the jute and putting it in boiling paraffine.

F. H. Varney: If you will remember your opening statement—the controlling factor in the cable was the size of the machine to armor the cable—did you consider with the manufacturers the possibility of building a special machine to armor a larger size cable? Isn't it a fact that the price of an armoring machine is not a great factor if you lay many cables of that size?

S. L. Naphtaly: We talked it over with the idea of getting a larger cable, but decided the advantages would not warrant the extra expense; and we also figured that if we had a cable over which we could really supply 5000 or 6000 kw., that was a good size unit for our conditions. We were satisfied to take something that they had. We did not want to go into more difficulty.

F. H. Varney: 5000 kw. is not a very great unit. For instance, to compare that with the size of a steam unit. I was wondering if you had figured at all on what it would cost to build a machine.

S. L. Naphtaly: We did not, but for our purpose we figured on a unit of 5,000 or 6,000 kw. doing what we cared to transmit. We figured that a certain number of those cables would take care of the amount of load that we wanted to transmit in the most economical way. We figured on three cables—two and a spare.

Question: About how long do you consider would be the average time to locate a burn-out and repair it?

S. L. Naphtaly: With the equipment which we expect to have I would say that they can be located, a joint made and put back in from twelve to fourteen hours. Of course I am inclined to think, from what we see of the thing, that if we get over this trouble we will have very little difficulty. Probably the fact that this tug caught us was because we haven't our cable crossing signs up, nor is our cable charted on the hydrographic maps. We have now got permission to put a proper sign up. The tug caught it with the propeller.

H. W. Crozier: Mr. Naphtaly has been very good to answer so many questions and now we would like to have some new ideas. It is suggested that perhaps Mr. Griswold, of the Pacific Telephone & Telegraph Company, might offer some information or some discussion as to experiences in repairing telephone cables in the same vicinity.

A. H. Griswold: Our cables are not power cables, but they are interesting to us. We have six or eight cables crossing San Francisco Bay, running from the old guttapercha cables to the more modern tri-core paper covered cables; and the installation of those cables has been a very interesting problem to us.

There is a limit of depth at which cables can be laid. We have a cable in Puget Sound at a depth of about 120 fathoms, and the pressure is considerable at that depth, and it was anticipated that the cable would not be a success. That is a loose core paper insulated, lead covered, armored cable. The British Columbia Telephone Company recently laid a cable in the northern end of Puget Sound in about 140 fathoms. The cable was manufactured in England, and was a guttapercha cable, its selection being due to the fact that the manufacturers would not guarantee a lead covered cable under that pressure. It is an interesting fact in connection with guttapercha cables, that the greater the pressure the better the insulation, due of course to the pressure on the rubber closing the pores.

The design of telephone cables has progressed considerably in the last few years, and they are getting more and more difficult to handle. We require for transmission purposes a very low capacity cable to give us the proper efficiency, and the cable has a very loose core; in fact it is so delicate in a way that in the last cable, which we laid only a few weeks ago, we found that its characteristics had changed considerably in taking it off of the reel on which it was shipped and putting it on the reel of the cable barge; and the tests which we made after performing that operation were considerably different from the factory tests which were sent to us, and necessitated making some different arrangements in the splicing of the cable.

We splice the cables approximately in the same manner that Mr. Naphtaly has illustrated, with the exception that we use a single sheath instead of a double sheath. The armor is served in approximately the same manner. We have in nearly every case spliced our cables before placing them on the submarine cable reel, and have had no difficulty with the splices after being laid.

The control of a cable reel by any gear arrangement I believe is undesirable, because in laying a cable you must not have any strain upon it, and at the same time you must not allow enough slack to permit the cable to kink in any way. Consequently, if you have some adequate type of brake arrangement by which you can regulate the tension on the cable quickly and accurately, I believe better results can be obtained than by any gear arrangement, unless that gear arrangement be of a particularly good sort that would allow you to make very quick adjustments.

Our later types of cables are interesting because we have been able to operate phantoms over them. As many of you know, we can operate a third telephone circuit over two circuits; that is, the two circuits carry the third. We do that by what we call a duplex cable, specially and carefully designed. In the first place, considering only four wires, or a quad, as we call it, the four wires at the factory are first carefully measured as to characteristics, resistance, and as to length, being exactly of the same length. Then the four wires are insulated and twisted together with a definite twist, absolutely the same number of turns per foot throughout the entire length of the cable. This is necessary to get a uniform cable as far as the transmission is concerned. It was found that in the ordinary stock cable, in twisting a pair, frequently instead of the two wires twisting uniformly one wire would wrap around the other, and the length of one wire would be considerably greater than the length of the other. By this particular method we are able to get a cable with the wires uniform throughout, and by it we also hope to increase the capacity—by capacity I mean the number of telephone circuits per cable, by carrying phantom circuits through them under the bay.

The question was asked about a larger armoring machine.

Perhaps some of you do not quite realize the size of one of these cables after it is armored. It is about as large as your arm, and as stiff as a piece of iron of the same size; and if you had a cable much larger than that it would be very difficult indeed to handle. It would be hard to wind it on the reel, and I imagine that it would not be much of a success.
such a way that it would not be much of a success.

D. P. Fullerton: I think Mr. Griswold has covered the point, but we have had a varied experience in cable laying. I believe that outside of the Western Union Company we probably had the first cable across the San Francisco Bay. The telephone company's first cable was laid in the early eighties, and consisted of a single wire rubber covered, and armored of course. Later on our cables developed, and for a great many years a 5 pair, and 7 pair, 14 and 16 gauge were our standard. In 1902 we laid our first paper cable. In those days we figured the average life of the rubber covered cable would be probably six or seven years. As a matter of fact some of them are in service today that we laid as far back as 1896 or 1897. In some of them certain pairs are broken down and are unfit for use except on very short lines, but others are giving good service.

In 1902 the first paper insulated cable was laid. It was a 28 pair. Since that time we have gradually improved the type of cable until now the last cable—the latest type which was laid a few weeks ago, is an 85 pair, and built up of 13 gauge, 16 gauge and 19 gauge cables. We have at the present time six cables between here and Goat Island; nine between Goat Island and Long Wharf; four across the Straits of Carquinez and three across the Heads.

In the early days of the paper cable a break was quite a serious thing for us, but today we do not find it so. We are pretty well equipped to take care of our troubles, and on a break we find time is the salvation of our cable. Further we find that the manufacturers have aided us greatly in the building up of the cables by the manner in which the paper is stowed away. We find now on a break that the water seldom goes back from each side of the break over 60 or 70 feet, which we consider a good factor in cable construction. We find the swelling of the paper compresses whatever air may be in the cable, which will in time prevent the water from going back more than 60 or 70 feet from the break.

We have had in the last year or two few breaks that forced us to abandon any cable. We found lately that it is an easy matter to take up any cable that is damaged and replace it and put it in good service. That includes the cables across the Golden Gate. For a great many years a cable that showed bad across the Heads was abandoned and a new cable laid. At this time it is an easy matter to get up that cable and relay it.

Our cables, the latest type, will approach in size the cable that Mr. Naphtaly just described. The last cable we laid I think weighed about 14 pounds or 15 pounds to the foot, and was close to 3½ in. in diameter. We have two cables across the Heads that are double armored. The first armor over the lead cable on the jute is No. 4 steel wire, and outside of that, laid in the opposite direction, is an armor of No. 2 mill steel wire. The double armor we found really necessary at the Heads on account of the swift currents and the rocky bottom. We are satisfied that in places our cables are suspended between rocks and over chasms, and that the swing of the cable in the tide wears it away and eventually causes a break.

We recently found that one of our cables was beginning to give trouble. When we took it up we found that the armor, considering the length of time that the cable had been down, in good condition; probably 25 per cent being eaten away; but where the trouble occurred the entire steel armor of the cable had been eaten away for the space of not over two feet and each wire tapered down to a point. There was a separation of an inch or two between the ends of the wire, and our only conclusion was that the cable had probably laid across some copper part of the old "City of Chester," sunk a few years ago, which possibly started some action.

We were very glad to assist Mr. Naphtaly in the handling of his cable, and I am glad to see that he has reverted to the idea of laying his cable in sections. For a cable of that size we would recommend always that it be laid in sections, and the splice made on board the vessel. We find no trouble whatever in making our repairs; and while we have had no occasion to lay a cable in sections, we have in case of trouble cut off one portion of the cable, the defective portion—sealed up the end of the other and dropped it overboard, and afterwards picked it up and relaid our cable.

Our greatest faith however in laying the cable is in the personality of the men in charge of the actual laying and the actual location of the faults, and that is where our success comes in in making repairs to our cables.

The cost of cable laying we estimate at an average of about 30 cents a foot; that is the actual laying of the cable.

There is one thing which I do not think Mr. Naphtaly did in his cable which we practice. Where the cable is spliced and the sheath put over, the lead sheath, where it is wiped at the ends, the wiping metal is tapered down so when the armor is relaid over there you don't have to splice gradually; and it enables you to lay on your armor practically as tight over the splice as was put on the cable originally, and we have had no trouble with splices in the last six or seven years to my knowledge. Our greatest trouble is the Stockton schooners who insist on picking us up with the anchor.

Referring to the question as to anchorage the barge in making repairs, with the mush-room type of anchor you have no trouble in following the cable. The mushroom will permit your barge to swing in any direction and will not foul any cable.

C. F. Elwell: Knowing that the members would be interested in what had been done in Europe in this connection I wrote over to the Compagnie de l'Industrie Electrique et Mechanique in Geneva, and received the following reply:

"We have already had occasion to study the use of submarine cables for a service tension of 150,000 volts direct current and carrying capacity of 150 amperes.

"So far as the cable itself was concerned, the question had been completely solved previously, and it was more particularly on the junction boxes that the tests were made.

"These tests have been absolutely satisfactory and we do not see any difficulty at all in the realization of the junction boxes, for those which were built for the experiments stood up to a test of 300,000 volts direct current after being intentionally submitted to mechanical effects powerful enough to tend to deform them.

"As for the cable itself employed by us it had a core of copper .116 square inch in section, which signifies a density of 1290 amperes per square inch. This density is not high as proved by the long tests on the underground cable of the Moutiers-Lyons transmission.

"The insulation consisted of a sufficient thickness of cellulose impregnated with a special material; over the insulation two seamless lead sheaths put on hot with a hydraulic press and separated from each other by means of a layer of thick pitch; over the last two impregnated papers, a layer of cordage, an armoring of No. 9 B. & S. steel wire and over all a winding of tarred hemp.

"Constructed for a service tension of 150,000 volts, the different pieces of the cable were all subjected to a tension of 300,000 volts for a quarter of an hour before shipment.

"The insulation was about 800 megohms per mile at 10 degrees C.

"The non-accessible junction boxes were made of lead sleeves.

"The European price of the cable insulated for 150,000 volts and constructed to carry 150 amperes with junction boxes was $3540.00 a mile, laying not included."

ELEMENTS OF TURBINE TESTING.[1]

BY ROBERT SIBLEY.

We come now to the important consideration of methods used in the commercial testing of turbines. It seems to be thorough standard practice, so far as Coast conditions are concerned, that turbines purchased from the large manufacturing concerns should live up to certain definite guarantees under strict rules of performance. In addition to the question of heat regulation, the most important feature of a turbine test is that of economy in operation.

Fig. 1. Illustration of a 12,000 kw. Turbine Under Test.

In Fig. 1 we have a picture of a 12,000 kw. Curtis turbine. Let us assume that this turbine is sold under conditions of guarantee for three separate load variations. For full load of 12,000 kilowatt output the steam consumption should not exceed 15 lb. per kilowatt hour. For 10,000 kilowatt output the steam consumption should not exceed 14.5 per kilowatt hour and for 7500 kilowatts the steam consumption should not exceed 15 lb. per kilowatt hour. Thus, it is seen that the most efficient operation is to be under a load of 10,000 kilowatts. The turbine under standard conditions is to operate at 200 lb. absolute and 28½ in. vacuum.

It is interesting and instructive to enter into details of the method used in performing a test of these proportions. In the first place let us consider the temperature determinations necessary, which are as follows:

1. Superheat.
   a. Main temperature.
   b. Stem temperature.
2. Condensate.
   a. Outlet No. 1.
   b. Outlet No. 2.
3. Circulating Water.
   a. Inlet.
   b. Outlet No. 1.
   c. Outlet No. 2.
4. Air Draft.
5. Barometers.
   a. Temperature of Vacuum Barometer No. 1.
   b. Temperature of Vacuum Barometer No. 2.
   c. Temperature of Atmospheric Barometer.

Referring now to the list of temperature measurements above mentioned, let us analyze them more closely. In Fig. 1 at A we see the inlet steam main through which live steam is just entering the turbine. At this point the two thermometers used in the determination of the superheat are placed. One thermometer is placed in the oil well which dips in the flow of live steam. The other thermometer is bound with this superheat thermometer but its bulb does not dip in the oil well, thus measuring only the stem temperature of the thermometer used for determining the superheat. We are thereby enabled to make the proper correction for the main superheat thermometer, since its bulb and outer portion are at different temperatures and consequently need to be corrected. The amount of superheat is of course determined by reading the pressure gauge denoting the pressure of the entering steam. The gauge must be properly standardized. By reference to steam tables, the temperature of saturated steam for this pressure is determined and the difference between this temperature and the corrected temperature above noted for the superheat is the proper determination for superheat.

The temperature of the condensate, which is the temperature of the water just formed by the condensed steam from the turbine, is measured at two different points or at as many different points as there may be, through which the water is forced by the wet vacuum pump into the hot well. In the practical illustration shown in Fig. 1 two such places are to be found shown at B and C in the diagram

In the case of the circulating water used to condense the steam utilized by the turbine, the water enters through a large main directly beneath the turbine and then divides outwardly through two separate mains. Hence to accurately determine the temperatures maintained by the in-going and out-going circulating waters, three temperatures are necessary. One is called the inlet temperature, the thermometer for which is placed in the supply pipe just as it enters the turbine condenser, and the others are called outlet thermometers Nos. 1 and 2 and are located similarly at the point where the circulating waters leave the condenser. No quantitative measurements are as a rule taken for the circulating water, the general capacity of the pumps are, however, noted. The all important point is to observe the difference in temperature of the in-going and out-going circulating water and should this come above an allowable amount either

[1]This article comprises the Twenty-third Lecture of a series appearing in these columns entitled "Primer of Applied Thermodynamics."

the condenser itself is working improperly or else an insufficient quantity of the circulating water is being forced through the condenser pipe.

At G, in Fig. 1, a thermometer is placed to keep a general tab upon the temperature of the in-going circulating air for the turbine generator. This thermometer is not absolutely necessary but adds to interesting data in connection with the test. Thermometers are also placed upon all mercurial barometers used in the test. For the turbine shown in Fig. 1 three sets of thermometers are used. At H thermometer No. 1 is placed since a vacuum barometer is here located. This is shown in Fig. 1 and a closer view in

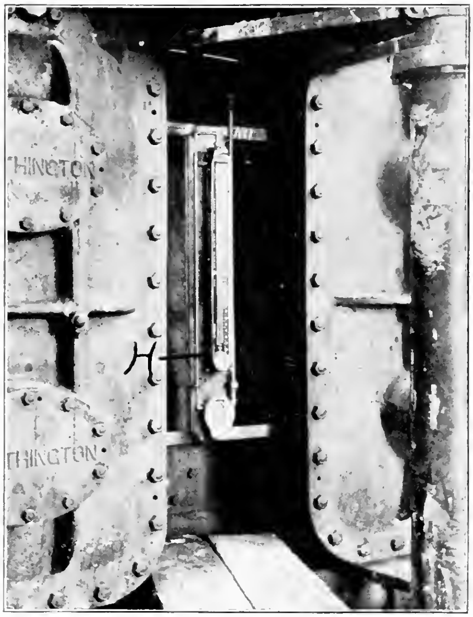


Fig. 2. Barometer Illustration for Measuring Condenser Vacuum.

Fig. 2. Diametrically opposite in the rear of the turbine, thermometer No. 2 is similarly placed to determine the temperature of the vacuum barometer there located. Thermometer No. 3 is placed at a convenient place near the turbine under test. This is used to determine the atmospheric pressure at all times during the test.

The following pressures are determined which are necessary for the gathering of complete data:

1. Pressure gauge for steam entering the turbine.
2. Pressure gauge for steam in first stage of the turbine.
3. Vacuum Pressure.
   a. Barometer No. 1.
   b. Barometer No. 2.
4. Atmospheric pressure barometer No. 1.

A carefully calebrated steam gauge is placed at J in Fig. 1 which is used for the determination of the pressure of the steam entering the turbine above referred to. Also at J is located a standardized pressure gauge, showing the pressure of the steam in the first stage of expansion in the turbine. Although not necessary, it is interesting and instructive to install additional steam gauges for the determination of steam in the remaining stages of expansion, for careful data of this sort is of much useful application and indicates any developments in the way of uneconomic operation of the turbine.

As the most accurate method of measuring any pressure is by means of the mercurial barometer, there should be installed at H in Fig. 1 such a barometer. Another similar barometer should be placed diametrically in the rear of the turbine. These two mercurial barometers will measure in inches of mercurial height the difference in pressure between the outside air and the vacuum within. Now if we have an atmospheric barometer situated nearby, which measures the absolute pressure of atmosphere in inches of mercury, we can, by taking into account the temperature of the mercury, compute accurately the vacuum obtained in the condenser.

By careful installation and reading of the differ-

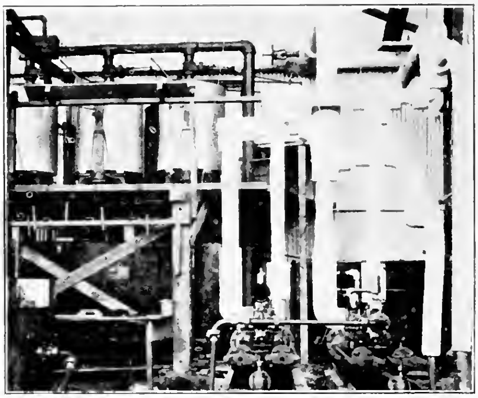


Fig. 3. Water Tanks Above Hot-Well to Measure Water From Turbine.

ent temperature and pressure devices above outlined the testing engineer can gather sufficient data to compute the water consumption, provided he has a careful and accurate method of measuring the condensed water.

There are two methods of measuring the condensed water—one is by constructing tanks of definite volume and keeping tab on the number of tankfuls dumped into the hot well, the second method is that of actually weighing each tank with its water. So far as accuracy is concerned, the second method is so satisfactory in every respect we shall only consider this process.

In Fig. 3 is shown three tanks which are placed upon scales carefully calibrated and standardized. These tanks are installed immediately above the hot well or placed where make-up water is formed. All of the water coming from the condenser is taken through pipes shown above the tanks in Fig. 3 and dumped in turn into them. As soon as one tank is filled, it is carefully weighed and this weight is then tabulated. By subtracting the weight of the empty tank, which is each time carefully weighed, from this gross weight

just tabulated, we arrive at the proper weight of the water per tank. The time of the emptying of each tank is carefully noted. At the end of a test of four or more hours the complete amount of water thus weighed is totalled which enables us to compute the weight of steam utilized in the turbine.

We come next to the measurement of the electrical output. Three separate methods are usually taken to determine this. The instruments should be carefully compared with some standard which itself has been calibrated at the United States Bureau of Standards and again calibrated as accurately as is possible when set up for the taking of the test. The instruments most preferred are those of the so-called indicating type, but for many practical purposes those of the carefully standardized integrating type are useful and accurate.

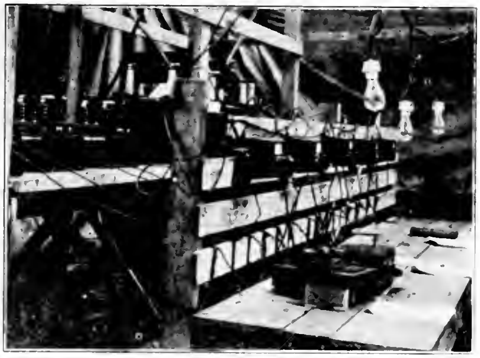


Fig. 4. Typical Arrangement of Meters for Measuring Electrical Output of Turbine.

When integrating watthour meters are used, as a rule, five are installed—two for the so-called two-watthour meter method, and three for the measuring of the power output in each phase. In addition to this an indicating watthour meter is placed across one phase so that the load under which the turbine is operated may at any moment be determined.

In addition to the alternating current measurement, the input of the direct current electrical energy used in the excitation of the generator fields is carefully measured. If now we divide the total amount of water condensed per hour by the known amount of power generated per hour we can determine at once the steam consumption per kilowatt hour for the turbine under test.

A SEA WEED INSULATOR.

In connection with the recent endeavors to use the kelps of the Pacific Coast as a source for potash it is of interest to note that an insulating material made from ordinary seaweed has been produced by an English chemist, Mr. John S. Campbell. Recent tests carried out at the Westminster Electrical Testing Laboratories are said to have proved it to possess all the ordinary merits of an insulator besides having an unusually high resistance. Immersed in water the test showed a resistance of 30,000,000 megohm-centimeters. Samples 1 mm thick withstood from 9000 volts to 16,000 volts alternating current before being punctured.

CRUDE OIL FROST PROTECTION.

To the Editor:—As to the number of pounds of crude oil or distillate which is required per acre per year to safeguard an orchard, I may say that this is a very difficult question to answer. Last year, 1911, was the worst year in the history of this district, as regards frosts, and some orchards required as much as 2000 pounds of oil per acre per season. The average, however, did not run so high.

Taking the acre as a unit, we estimate that in the average orchard, with the trees in full bearing, there are about 500,000 cubic ft. of air to be heated. In going over my experimental data, I have found that it will require approximately 1 B.t.u. per cubic foot per hour to maintain the temperature one degree above that of the surrounding atmosphere. In other words, 500,000 B.t.u. are expended per degree F rise in temperature per acre. This rise in temperature is secured by the burning of about 30 gallons of crude oil or distillate. Now, the average distillate or crude oil contains approximately 18,000 B.t.u., but, of course, the full efficiency of the oil is never secured in burning as we are compelled to burn it in a crude orchard heater. From the above data, you can easily estimate how much electrical energy will be necessary to maintain the same temperature conditions. Under average conditions, a rise of 50 degrees F. or more must be secured to keep the fruit above the danger point. We have instances where a 10 degree rise was necessary.

You will see by the above that in maintaining temperatures in an orchard requires the expenditure of an enormous amount of energy. If electrical energy is desired in the form of heat you will see that to cover an area of 1000 acres would require an enormous plant to carry the peak load.

[1]No doubt, you have in mind the matter of protecting from frost by the use of electrical energy in a different form than by the use of heating appliances. You probably have in mind the use of large fans to keep the air in motion, or perhaps high tension discharges. Some work along these lines has been done, but I think that it is of little practical importance. Going back to the matter of using electrical energy in the form of heat, aside from the impracticable part of using costly heating appliances, the amount of power necessary would put it out of the range of possibility, or rather practicability. By referring to the figures on the acre you will easily see that to raise the temperature 1 degree F. would require practically 200 h.p. of mechanical energy, not even considering transmission losses or anything else.

Although my work is pathological and entomological, I am also an electrical engineer, having had some practice in the building and designing of power plants and electrical apparatus. However, engineering is only an avocation with me and I work with it for the mental amusement I now find in it.

P. J. O'GARA,

Pathologist in Charge and Special Meteorological Observer, U. S. Weather Bureau, Medford, Ore.

[1]See Journal of Electricity, Power and Gas, March 2, 1912, Editorial Page.

PRACTICAL ADVERTISING FOR PUBLIC SERVICE CORPORATIONS.

BY J. W. SWAREN.

While the advertising of a public service corporation is largely different from other types of advertising in its appeal,, the peculiar conditions surrounding it, and the nicety with which it elucidates, when properly done, several of the most discussed questions of advertising, makes it deserving of more study than is usually given, especially by those who are most vitally affected by its results.

Strictly speaking, public service corporations include local servitors as the telephone, gas or electric supply, street car and similar utilities. More generally speaking, long distance telephone, telegraph and transportation and other companies are included, and each of those of the first named class of utilities, fade insensibly into those of broader import.

Until recent years these companies have relied, where they thought the public worthy of enlightenment on any point, upon the wiles of the press agent, or in some more notorious instances on the control of a subsidized press. The manager of the utility corporation regarded the publisher as a hold-up man of the purest breed, while the publisher reciprocated by considering the utility company legitimate prey. I regret to say some companies still follow this idea. But with modern tendencies, the more sagacious managers of these corporations are turning to display columns and some of the most consistent campaigns ever conducted in the advertising field have been, and are being carried on by corporations of this class. The effect created has been far reaching civicly, morally and mentally.

Three important ultimate results stand before the advertising manager of a public service corporation.

First: Moulding of a favorable public opinion.

Second: Prevention of inimicable legislation.

Third: Increased sale of the utility under consideration.

Every piece of copy, it matters not the particular aim in view, must be prepared with these three essentials in mind; and phrasing, illustrations, and ornamentation, must be consistent with this main frame. To accomplish these three ends, at times at contrary purposes to each other, requires a certain degree of finesse and a deep insight into the primordal instincts of human nature. Time forbids touching on these requirements, interesting though they be, but I hope in a later paper to describe some of the means commonly employed to increase the efficiency of advertising copy, and particularly those used to influence the unconscious inclinations of the mind.

In the main, public service advertising is general publicity work. It is doubtful if any term has been more discussed and cussed and less understood than that old scape goat, "General Publicity." Rightly approached and properly handled, no form of advertising is capable of greater development, and, though of a subtle nature, of direct, tangible and measurable results. But generally speaking, the man who cries "General Publicity" the loudest, understands it the least, largely because he has not taken the pains to investigate its fundamental laws.

Moulding public opinion is not done by the beat of tom-toms or the blare of a brass band, but it is that constant entering into the life of the home, until the impression it is desired to create unconsciously becomes a second nature to the public at large.

Taking up concrete problems we will examine the last essential mentioned above "Increased Sale of the Utility." First: Advertising and sales department must co-operate in the fullest sense. Neither must be allowed to dominate. The advertising is the pioneer, figuratively speaking, building trails into the wilderness, here and there opening up a rich mine of business and permeating the entire field as the leaven of the yeast permeates the loaf.

The selling department follows after, and corresponding to the agricultural interests following the pioneer, covers the entire field until the maximum production of business results. In public service corporation work, this analogy can be carried a step farther.

The farmer first entering into new country skims the high spots and robs the soil. Press of competition, (here competition is used to cover in one term all of the pressure brought to bear on a public service corporation) forces him to more intensive cultivation, and the sales manager of the public service corporation must inaugurate a fine tooth comb campaign of the territory under his jurisdiction.

In passing, this paper is based on an assumption that any public service corporation inaugurating an extensive campaign for business has established its physical conditions as solidly as circumstance surrounding its operation, will permit. Only good goods can be advertised successfully, and this applies with double importance to the public service corporations. After this, enthusiasm in the advertising, and zeal in the selling, but consistency between the two and a level headed manager to balance and utilize every constructive move.

Take an electric appliance campaign, as an example. The toaster can be used for one series of effort. Put a force of solicitors, using sample toasters if desired, with instructions to visit and sell every house connected with the system. Instead of having the prestige that normally is associated with the representative of an important business, the solicitor will be received as an ordinary canvasser, and half, yes, two-thirds of his energy and possibly his time will be spent in getting a footing with his prospective buyer; all weight and prestige of an important industry being willfully cast away.

Precede these men with a well balanced campaign of clear cut reason why copy, continuing through the actual canvass, and unconsciously, perhaps in many cases consciously, his call will be expected, little or none of his energy being expended in placing himself on a proper footing with the prospective buyer.

It is not probable that a direct mention of the fact will be made, but unconsciously through the mind of the prospective buyer will run this thought "Oh, that's one of those electric toasters that makes possible those dainty breakfasts I saw planned the other morning in the Tribune." But here is where many electric service companies have failed, and here is where you, should it come within your province,

to deal within this class of advertising, can avoid a pitfall.

A few moments ago I used the term, "reason why copy" and by this I do not mean the hammer and tong arguments, the irrefutable figures that are ordinarily associated with this term. By "reason why copy" I mean copy that will show the consumer that it is to the advantage of his pleasurable benefit, as well as his pocket-book, to make a further use of the available utilities. This copy must cover three points.

First, it must appeal to their sensible pleasures.

Second, it must make a presentation within financial reach of the utility user.

Third, it must be tied in with local civic interest.

A large portion of the utility advertising, and particularly electric utility advertising, has been prepared by the appliance manufacturers. A common example of the toaster under consideration shows it on a breakfast table, dominating the scene, two insipid figures possibly, a few words crying the toaster and some more or less senseless patter about the joys of using the "Jim Crack" toaster, (of course no other will fill the bill) but not one word of the service nor the institution behind it, a clear ignoring of our first and second essentials in public service advertising.

Yet this is a class of stuff to which many of the largest utility companies have signed their names, and is their ideal of new business getting.

Why not this?

In the upper left hand corner a pen and ink sketch of a water power plant set in the canyon, with the water rushing down the mountain side, a pair of wires strung across the page and at the lower right hand corner a breakfast table. "This Power Will Bring You a Dainty Breakfast," will be the headline; fill in with a short talk on the use of electricity in toasters, percolators and egg boilers, with particular reference to the toaster. In a conspicuous place at the optical center of the space if the balance permits, print an appetizing breakfast menu, and its cost in terms of current. A few closing words about the demonstration campaign and a clear cut signature of the company. Have this conform with the names on your wagons and letterheads, in fact wherever the name of your company appears, have it uniform, a symbol of your activities.

Another theme would show the steam reserve plant and the heading "To Make Your Breakfast Certain." A few words calling attention to this link in your chain of service and a different menu of course. But the various links in the service could furnish copy, each with a fresh view point, for every day in the year. It is not a question of where to get ideas, but a question of what to use. Now then analyze this copy in the light of the three basic requirements.

First, the moulding of a favorable public opinion. This feature of showing the great pains that have been taken to perfect every detail in the chain of service offered cannot help but create a favorable impression on the public, and will unconsciously create a friendly feeling toward the utility company.

Second, the prevention of inimicable legislation. The human nature at heart is selfish, and every user of electric energy, or any other utility who actually knows something of the conditions under which he is served, will resent any regulation that will tend to unfavorably affect his relations with this service. At first glance this might seem an argument that could be turned into a favorable argument in an agitation for lower rates. Should this result, a plain statement in the display columns if you please, and not press agency of the company, showing exactly what the results of decreased rates would mean, would go far towards counterating any such agitation, in fact, you will have established the firmest foundation for combating such a campaign.

As a by remark on public service corporations in general, permit me to say that seldom does the public object to the price, if reasonable, it pays for any service, provided the service is of the highest quality, and this returns to a point I made previously, that before any public service corporation can start a successful campaign, it must be in adequate physical condition.

It is an actual fact that even the heaviest campaigns of this type will bring comparatively few replies to the office, but if you ever have the opportunity of checking the cost of sales in two similar towns, one where the selling campaign is preceded and accompanied by advertising, the other without this assistance, you will find the cost per appliance in the unpreceded campaign from two to five times greater than in the supported campaign, including the cost of the advertising.

But one important essential is co-operation, between engineering and sales on one side, between sales and advertising on the other. With a management honest enough to put their proposition square before the people, the maximum development of electrical service will result.

ARRANGEMENTS FOR N. E. L. A. EXHIBITS AT SEATTLE.

The exhibition committee for the thirty-fifth convention of the National Electric Light Association, to be held at Seattle, Wash., June 10 to 13, has announced the arrangements for the exhibits. J. C. McQuiston, Pittsburg, Pa., is chairman of this committee. The convention headquarters will be in the City Armory and the exhibits will be placed in the Drill Hall, which measures about 200 by 100 feet. One end of the hall is cut off by a double partition, forming a spacious meeting hall. The exhibit hall has been laid out in such a way as to provide 70 booths of good proportions, with an aggregate floor area of 8,150 square feet. Regulation prices for space will include platforms, signs, decorations and unlimited telephone service. Two chairs will be furnished free and additional furniture may be secured at schedule rates. Through the courtesy of the Seattle Electric Company, current for lighting and for the operation of exhibits will be furnished without charge. This current will be single-phase, 60-cycle, 117-234 volts.

To reduce the expense of shipping exhibits from the East the committee is making arrangements for grouping and reshipping material from Chicago in carload lots.

ENGINEERING SPECIFICATIONS.

BY R. G. McDONALD.

A short while ago the writer had occasion to read a set of specifications covering the hydraulic equipment for a municipal plant. The reading suggested the idea of starting a discussion along these lines.

The particular set, referred to above, were not extraordinary in any particular, but represented the average. They had the fingermarks of having been either largely copied from some book or were cut down from some other job to partially fit the conditions of the present work. The principal objection, however, was that there were at least two clauses which were impossible of fulfillment, and that they practically designed the equipment and at the same time required the builder to make stringent guarantees.

In what follows, the writer feels that there is some good logic. This, because he once tried the thing out by issuing two sets of plans and specifications covering a large hydroelectric and irrigation system. One set was written to exactly meet the requirements of the work, taking into account the working conditions from the contractor's point of view. The other was made arbitrary and considered only the viewpoint of the critical engineer. They were minute in their detail, called not only for a certain class of finished work, but stated methods of procedure. They designed equipment, then required results thereon. The final result was that there was a large difference in the bids submitted. It is needless to say that the contracts were let according to the first named scheme, with the glorious result that a job was secured that is equal to any.

It is the writer's notion that a good set of specifications should meet the following conditions and requirements.

They should not be standard, "cut and dried," but be written especially for each piece of work, based on a careful study of the requirements of each job.

They should be so drawn that the contractor has liberty to use his ingenuity and skill, so long as the class of work is not impaired.

They should be clear as to their intent and meaning, avoiding all superficial matter.

They may call for tests and quantities of materials, although it is better to furnish as many of the important materials as possible.

In case they cover machinery it is best to call for results of rigid tests, allowing the manufacturer the privilege of doing his own designing. There are few plant designing engineers who are competent to take the responsibility of designing the machinery proper. Therefore, they always make the manufacturer responsible for results as well. The engineer referred to above is in fact a correlator of machinery and should leave the other operations to those who are specialists in their lines.

Allow only reputable concerns to submit bids and put them under bond to guarantee the performance of apparatus, etc., for a period of time consistent with good judgment.

Prejudice should not influence the wording to admit or preclude certain equipment materials.

WIRING COSTS.

The great uncertainties regarding costs of installation are largely responsible for the present hazardous reputation of the electrical contracting business. The Sterling Electrical Manufacturing Company has compiled much valuable data on costs in installing the Mazda lighting system. The following is gleaned from their recent excellent publication entitled from Posthole to Lights On.

Cost of Carrying One Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

52 35 ft. poles assembled and set 100 ft. apart, $7.50 each	$390.00
Stringing 3 wires one mile	12.50
3 miles of No 6 weatherproof copper wire (or 3 1 mile wires) 15,840 ft., or 1760 lb., at 14½c. per lb.	255.20
	$657.70

Cost of Carrying Three-Fourths Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

40 35 ft. poles assembled and set 100 ft. apart, $7.50 each	$300.00
Stringing 3 wires ¾ mile (3960 ft.)	10.00
2¼ miles of No. 6 weatherproof copper wire (or 3 ¾ miles wires) 11,880 ft., or 1320 lbs., at 14½c. per lb.	191.40
	$501.40

Cost of Carrying One-Half Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

26 35 ft. poles assembled and set 100 ft. apart, $7.50 each	$195.00
Stringing 3 wires ½ mile (2640 ft.)	8.00
1½ miles of No. 6 weatherproof copper wire (or 3 ½ mile wires) 7920 ft., or 880 lbs., at 14½c per lb.	127.60
	$330.60

Cost of Carrying One-Fourth Mile of Wire From Source of Supply to Distributing Station In Town.
High Tension 2200 Volts (3 Wire) 5% Drop.

13 35 ft. poles assembled and set 100 ft. apart, $7.50 each	$ 97.50
Stringing 3 wires ¼ mile (1320 feet)	7.00
¾ miles of No. 6 weatherproof copper wire (or 3 ¼ mile wires) 3960 feet, or 440 lbs., at 14½c. per lb.	63.80
	$168.30

Note.—The No. 6 wire specified in above primaries will carry 50 amp. one mile at 2200 volts with about 10% line loss and when transformed to suit commercial, power and street loads will supply 500 to 1000 amp. or about 100 kw. to the secondaries, depending on their voltage.

Cost of Constructing One Street Lighting Circuit Over One Mile of Streets From Distributing Station in Town.
1100 Volt Series Circuit 6.6 Amp. 10% Drop.

35 25 ft. poles assembled and set 150 ft. apart, $3.50 each	$122.50
Stringing 1 wire one mile	7.50
1 mile of No. 6 weatherproof copper wire (1 1-mile wire) 5280 ft., or 587 lbs. at 14½c. per lb.	85.11
	$215.11

Note.—The above circuit will accommodate a load of from 6 to 7 kw., or 60 to 70 80 c.p. Mazda street lamps or 80 to 90 60 c.p. or 120 to 130 40 c.p., or an assortment of the above lamps up to the kw. capacity or voltage of the line. The lamps must all have the same amp. draw regardless of their voltage, to work in series.

No. 6 wire may be used for a series circuit 1½ miles long, the cost of constructing same to be figured on same basis as the mile circuit given above, such a circuit would require about 53 poles with the additional cost of a half mile of wire and a proportionate increase in the cost of stringing the wire. The capacity of this circuit would be less than the mile circuit on account of the extra drop due to the extra length of circuit, accommodating perhaps 50 to 60 80 c.p. Mazda lamps or their equivalent representing a load of about 5 to 6 kw.

Alundum is an artificial refractory made by purifying and fusing bauxite in the electric furnace. It has a melting point of over 2000 degrees C. and is used in the manufacture of fire-brick, crucibles, muffles, etc. Experiments at the plant of the Norton Company of Worcester, Mass., showed that while alundum firebrick outlasted silica brick as a roof for electric steel furnaces, its higher cost did not warrant its use. For laboratory apparatus alundum is eminently satisfactory.

THE ELECTRICAL DEVELOPMENT LEAGUE.

Ding, ding—dong, dong,
Goodwin hit the bell
With an "ad" seven blocks long
"Prices shot to hell."

From the moment the curtain rose at the noon meeting in San Francisco at Tait's Cafe, March 12, 1912, by the proposal of T. E. Bibbins and others to start, if possible, a loud grievance commotion somewhere in the harmonious gathering until the closing of this scenic effect by the proposal of W. S. Goodwin to place an "ad" on Market street with the above insertion, the meeting was full of energy and ginger. Even the recent achievements of J. A. Vandegrift at golf were momentarily forgotten.

The different events followed in interesting alignment. Geo. C. Holberton, president of the league, opened the program by announcing that the Pacific Gas & Electric Company would hereafter cease making service charges and there would undoubtedly follow a large increase in the purchasing of electrical fixtures and novelties in which the entire electrical fraternity would share.

J. W. Redpath, a member of the publicity committee, then made an interesting report. Near each plate at the table was found a paper napkin upon which was neatly and attractively printed a copy of the peoples' electrical page now appearing in the Cleveland Plain Dealer. In addition, artistic sketches, depicting electrical uses in the home, were passed around as suggestions for the running of an electrical page in the San Francisco daily press. These suggestions were characteristic of forceful advertising. An item could be found here which at once caught the eye, and, again, something was found to excite the curiosity and, finally, the reader was unconsciously lead into reading the entire page which bubbled over with little educative points in household applications of electricity from curling irons to bungalows, the householders' attention was held fast.

The postal card idea was also the recipient of hearty endorsement. It is proposed to have a certain day similar to the "California Invitation Day" of some time back, in which thousands of cards were at that time mailed to all parts of the world, setting up the attractive features of the great "poppy State." In the electrical postal card scheme, it is proposed to send cards on a certain date to all consumers of electricity in and about San Francisco. Upon these cards are to be printed points of human interest in the electrical game—water-falls, rivers, interior of power plants—anything and everything to arouse interest in consumption of electrical energy.

Interesting discussion then followed. Considerable sums of money were indicated as being ready to start the project under way. E. B. Strong urged that an immediate starting of this publicity campaign on the part of local electrical men could not help but bring out hearty support of the eastern manufacturing companies. Holberton, Bibbins, Carter, Hanbridge, Levy and Goodwin all took part in the discussion. Each had views differing from the other, but throughout the entire meeting it was evident to all listeners that each had at heart the proposing of the best means to harmonize and unify electrical interests and a deep felt spirit of co-operation in order to make the electrical industry profitable for all concerned. In fact Col. Carter, president of one of the leading jobbing houses, stated that he felt the electrical page would mean so much to his house that he would subscribe very heavily, if all the other jobbers present staid out. This statement brought forth humorous applause, and all caught the forceful argument intended; namely, that the electrical publicity campaign would mean much to all, and especially to those standing ready to boost the proposition financially.

The entire publicity proposition appeared in such a favorable light it was finally moved and carried that the publicity committee in conjunction with the president of the league bring to the next meeting a detailed scheme for a daily electrical page to run in the San Francisco press for a period of three months.

The meeting then adjourned and each man present felt a stronger and more wholesome spirit was even thus early being engendered by the electrical Development League, all of which augurs well for its continued existence and prosperity.

NEW PLAN FOR INCANDESCENT LAMP SALES.

On March 1st there was inaugurated a new plan of distributing incandescent lamps, in order to conform to certain legal requirements as enunciated in a recent decision of a U. S. District Court.

Under this new plan no sale is made except to a consumer or user of lamps, the distribution from the manufacturer to the consumer being accomplished by agents or distributors of which there are two classes equivalent to jobbers and dealers.

The manufacturer does not sell his lamps to these distributors, but appoints them as his agents and allows each of them a compensation for handling the business.

The lamps remain the property of the manufacturer until paid for and it is thus possible to maintain a uniform sales price on the part of all handling lamps covered by patents.

The lamps will be sold without restriction as to re-sale prices. The properties of the constituent companies of the National Electric Lamp Company have been transferred to the General Electric Company and those companies will hereafter conduct their business as a part of the General Electric Company.

CO-OPERATIVE TELEPHONE SYSTEM IN MEXICO.

A concession has been granted to a number of merchants in Monterey for the operation of a telephone system in that city on the co-operative plan. The plan of the originators of the idea is that each subscriber should own his telephone, and there will be not less than 4000 subscribers who will also be stockholders in the new company. The telephone lines will be operated by the underground cable system.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

An Appeal to Western Engineers

Thus far the concerted action of western engineers in assisting the getting together of the greatest engineering congress of history at the Panama-Pacific Exposition in 1915, may be likened to the modern steam turbine when relieved of all the load and merely "floating on the line." Western engineers have been in thorough synchronism with the movement, having assisted in maintaining a maximum power-factor, and have even aided in preventing undue surges of a destructive nature, but so far as the actual carrying of the load is concerned, the recording instruments fail to indicate any appreciable deflection.

The congress of engineers at St. Louis was most helpful. The civil engineers in particlar had a most notable gathering. A splendid array of papers was given to the world, but when the American Society of Civil Engineers began to foot up the bills, it was found necessary to dig up from their national treasury the sum of $38,000.

The Journal some weeks back, published a copy of the invitation which has been sent to all the national engineering societies. This invitation is held in the most favorable light. Official representatives of nearly all the great engineering societies have visited San Francisco during recent months. These men feel, and justly too, that the engineers of the Coast ought to stand ready and willing to contribute a portion of a $50,000 guarantee to meet possible contingencies. In a word, they feel that the coast engineers should pledge themselves to the extent of $10,000 to insure the success of the undertaking, before the national societies put their official sanction and guarantee upon the project

This appeal is now being mailed to the prominent engineers of the Coast. No obstacle has ever been allowed in the west to prevent her onward progress and ultimate triumph. Loyalty, open-heartedness, generosity—synonyms of the West—surely these characteristics will predominate in this urgent cause!

San Francisco Bay Cable Crossing

The whole world was interested and amused last fall when three daring young mermaids swam across the Golden Gate at San Francisco, which had hitherto baffled all attempts on the part of feminine ambitions. The city of San Francisco has now another maritime feat to its honor, but, this time, it comes not from the athletic prowess of its citizens, but is an outcome of the keen competition of the great power companies of central California.

An aerial or submarine crossing of San Francisco Bay has been thought of and discussed for years. Indeed, long since would there have been an aerial power crossing over the Golden Gate, which would have made the crossing at Carquinez straits—the present greatest project of its kind in the world—insignificant in comparison, had not the War Department, ever jealous to guard against a weakening of national strategic points, frowned upon the idea.

It is interesting to review in mind the methods used by the various hydroelectric companies in trans-

mitting their power into San Francisco. The forerunners of the Pacific Gas & Electric Company, after being denied by the War Department the privilege of an aerial crossing over the Golden Gate, decided to bring their power around by the southern end of the bay, thus shortening the distance of a subsidiary line into the growing city of San Jose. The San Francisco & Sierra, a recent installation of high order, preferred crossing over the bay immediately to the south of Dumbarton Point. This was accomplished by steel towers placed 1600 ft. apart. The foundations for these towers were prepared by driving piles and filling with concrete. Though higher towers were necessitated, yet a remarkably sound construction, having every appearance of permanency and durability, was effected. In addition, too, the standard uniform make of tower was not varied from.

Now comes the Great Western Power Company, cutting the Gordian Knot, as it were, and effecting a short and efficient crossing by submarine cables. One of the most striking features of the installation is the ease with which faults are detected and the accuracy with which they are located.

The Telephone Problem

The problem of absorption of the independent telephone systems on the Coast by the older and more powerful company each day becomes more acute. Seattle, Tacoma, Portland, Los Angeles and San Francisco are being shaken to the quick with the agitation.

At first sight it would seem of but passing interest to the citizens of the various municipalities affected. In fact, the prospect of having to pay for but one telephone in the future, thus doing away with the duplication nuisance, appeals so strongly to the merchant that often he heralds with joy any combination whereby this seemingly heavy burden may be dispensed with in the future. But—ah—how careful we should be to see to it that the burden is in reality taken away forever, and not placed upon us in another form!

The proposition is simply this: An enormous quantity of reduplication work has been brought about by the independent telephone companies in the great cities of the West. Under no possible economic system could these institutions be absorbed into the older company and yet make possible the economic utilization of the entire expensive reduplication work. We must consider that the people, having undertaken the responsibility of regulating the great public service corporations, are morally bound to see to it that the corporations get fair play. If this combination is allowed, unless a proper protest is now made, we shall be duty bound to allow this combined company to earn an interest throughout eternity on the combined investment, even though the major portion will not materially aid in effecting economic telephone service. In a word, if there must be a loss, let the ones who gamboled on the original reduplication now shoulder the fortunes of the god of chance.

In the study of astronomy we are told that the only way we can get a clear idea of the roundness of the earth, and a comprehensive idea as to how the earth rotates about the sun instead of the sun about the earth, is for us to picture ourselves out in space away from our surroundings. And so it is in the affairs of life, the only way we can deal out absolute justice to our fellows is for us to journey outward into space and soar above the hurly burly, jealousies, dislikes, selfishness and avarice of human life.

In the case of the telephone combination, it is not right, because an unwise investment may have been made on the part of the original promoters, that we should guarantee an interest on this mistake throughout eternity, thus forcing upon our children's children an unjust and unfair burden. The entire affair should be carefully reviewed by the respective public service commissions and whatever seems just to allow in the way of added efficiency by taking over the new equipment should receive the stamp of approval—not one cent more, nor one cent less.

The Proposed Closing of the Mint

It is, indeed, true that we live in an economic age—an age where every excuse for the existence of an industry must be carefully weighed in a balance and if found wanting from an economic point of view, the enterprise should be cut forever from our national life.

The eastern states grew and waxed strong from their natural inheritance in forests, water powers, oil and coal fields, and yet many of these self-same states are now loud in speaking against allowing our western states the same privilege. In fact many of the current proposals for development of natural resources in the west would hobble our growth by delaying our development a generation or two, and the worst of these proposals is to put into the national treasury funds derived from these western resources. These should unquestionably be immediately put back into the section whence they came.

And now comes the proposition to close down our mint—the pride of the west for practically half a century. The San Francisco mint has been a fitting tribute of a proud nation to the mineral wealth produced in the West. Not for one minute, however, should sentiment be allowed to outweigh the inexorable decree of the Darwinian Law—the survival of the fittest.

The great Rocky Mountain range, like the British channel, stands forever a natural barrier between the east and the west. No matter how delicate may be our financial clockwork, this isolation will be felt. When the greatest fire of history swept over San Francisco, destroying practically every private enterprise, the mint, the customs house, and the postoffice were saved. Why? Because a great government stood by to protect. Talk not to the citizens of the coast that private enterprise could possibly afford the same substantial guarantee in the coinage of our moneys—an act which is in a sense the very heart throbbing of our nation.

Our very life as a commercial factor depends upon the security of our monetary matters.

Let us then see to it that this security is not impaired even though we pay a premium for this insurance. Briefly, but emphatically, the San Francisco mint must not be closed.

PERSONALS.

H. R. Noack, president of Pierson, Roeding & Co., is at Los Angeles.

H. R. Johnson, who has light and power interests in Montana, is at San Francisco from Butte.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is at Los Angeles visiting the branch office.

R. D. Holabird, president of the Holabird-Reynolds Company, has returned to San Francisco after visiting Seattle on business.

F. A. Richards, manager of the car department of Pierson, Roeding & Co., is in the Pacific Northwest on business for the firm.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company of Milwaukee, is at Seattle after spending a week at San Francisco.

H. L. Bleeker, vice-president of the Washington Water Power Company, has returned to Spokane from a visit to Southern California.

Milton E. Wise, formerly with the Street Railways Advertising Company, is now advertising manager for the Great Western Power Company.

L. P. Gates, superintendent of the car department of the Pacific Electric line of the Southern Pacific Company at Los Angeles, is at San Francisco.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard and Supply Company, has returned to San Francisco after a trip to the Chicago office.

C. G. Young, a prominent consulting engineer, is at San Francisco on a tour of the Pacific Coast investigating various properties for eastern banking interests.

F. A. Somers, of the Westinghouse Electric and Manufacturing Company's district agency, has returned to San Francisco after visiting Southern California.

The Stone & Webster Construction Company has opened a purchasing agency which is in charge of F. T. Barry at 415-417 Rialto Building, San Francisco.

J. D. Ross, electrical engineer of the Seattle municipal light and power plant, is now chairman of the Seattle Section of the American Institute of Electrical Engineers.

W. W. S. Butler, vice-president and general manager of the Western States Gas and Electric Company, with headquarters at Stockton, is a recent arrival at San Francisco.

C. M. Clark, who is the principal owner of the Portland Railway, Light & Power Company, is at Portland on his annual inspection trip, after spending some time in Southern California.

F. N. Baylies, manager of the Chicago office of the Aluminum Company of America, is spending a few days at San Francisco on his way homeward after enjoying a vacation at Los Angeles.

E. W. Rollins of the firm of E. H. Rollins & Sons, of Boston, who are heavily interested in the financing of the Great Western Power Company, is visiting the firm's San Francisco office after having spent the winter in Southern California.

H. E. Grant has resigned as sales agent for the British Columbia Electric Railway Company, Ltd., at Vancouver, B. C., after five years' service. Mr. Grant has received offers from several firms but will travel in Southern California for a time before establishing new business connections.

Gano Dunn, the president of the American Institute of Electrical Engineers, will arrive at San Francisco early in April, en route to the Pacific Coast Convention at Portland, which opens April 16th. He will visit the San Francisco office of J. G. White & Co., of which firm he is the vice-president.

Rudolph W. Van Norden, consulting electrical and hydraulic engineer, has returned to San Francisco from Los Angeles.

Cal. E. Goodrich of Minneapolis, who is president of the Twin City Rapid Transit Company, which furnishes local and interurban electric railway service for Minneapolis and St. Paul, Minn., is at San Francisco.

Henry C. Hazzard has resigned as chief of the division of light, heat and power with the New York Public Service Commission to assume a similar position with the Railroad Commission of California.

H. A. Lardner, manager of J. G. White & Co.'s San Francisco office, will go to Portland to meet A. S. Crane, the company's hydraulic engineer, who will arrive there from New York next Monday. They will spend some days in engineering investigations for the Portland Railway, Light and Power Company.

S. L. Shuffleton, who has charge of the Stone & Webster Construction Company's engineering work in California, has opened a large office in Fresno in connection with the construction of the Big Creek power plant of the Pacific Light & Power Corporation. A considerable force of hydraulic engineers, draftsmen, etc., will be engaged on the above work.

J. B. Rannie, who has been for a long time connected with the British Columbia Electric Railway Company, Ltd., latterly as traffic manager for the Vancouver lines, has been promoted to the post of general traffic agent. Jas. Hilton, formerly connected with the Montreal Street Railway, succeeds Mr. Rannie in charge of the Vancouver branch of the company's system.

Charles T. Phillips, consulting engineer, is at Roseville, Cal., preparing to design a municipal substation, street-lighting system and a distributing system for commercial light and power. The city is now purchasing electric power from the Great Western Power Company for 1.5 cents a kilowatt-hour and will also retail the same in future. Funds have been raised by a bond issue.

Ralph L. Phelps, Pacific Coast manager for the Safety Insulated Wire and Cable Company, is at Sacramento superintending the laying of a very heavy submarine cable in the Sacramento River in connection with the operation of the Northern Electric Railway Company's new drawbridge. The cable is heavily armored and has a cross section of 1,500,000 circular mils. It is the largest capacity direct current cable made.

Walter Arnstein, vice-president of the Oakland, Antioch & Eastern Railway Company, has returned to San Francisco from the East after completing the financing for the extension to Sacramento. It is understood that the contract has just been closed for this final section of the road amounting to fifty miles. J. G. White & Co. have the engineering supervising. J. M. McCampbell of that firm, who is supervising the work on the tunnel, will also have charge of the new railroad work which will be commenced in the near future.

L. G. Robinson, who has been for the past three years associated as assistant with the engineering forces of the British Columbia Electric Railway Company, Ltd., has resigned his post and will enter upon practice as private consulting engineer in Vancouver, B. C. Mr. Robinson was formerly connected with the Shawnigan Power Company and Ontario Power Company in Eastern Canada and among his early work in British Columbia acted as assistant to Mr. Le Baron in his plan for the reclamation of the lands about Sumas Lake.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

Hale Bros. are receiving bids for a five-story building on the corner of Fifth and Market streets. The ground plan is 137½ by 165 feet. Reid Bros. are the architects.

Don't forget the annual meeting of the National Electrical Contractors' Association in Denver, Colo., July 17-18-19, 1912. Your friends will want to see you there. Round trip fare, $55.

The electric wiring for the new Sharon estate building on Jessie, New Montgomery and Stevenson streets, has been awarded to the Pacific Fire Extinguisher Company for $7800.

Bids are being taken for the electric wiring on a large hotel on Bush street and Grant avenue which, will amount to $7000; also one on Taylor and Geary streets which will amount to $12,000.

The Pacific Gas & Electric Company have announced their intentions of giving free service connections in the future on all their lines. This move will cause a large saving on the part of the consumers, and all contractors should show their appreciation of this move. While many contractors feel that the company should make these connections free, let us take advantage of the present move and induce people to connect to the lines, thus making business for ourselves.

SUBSCRIPTIONS FOR INTERNATIONAL ENGINEERING CONGRESS.

As a factor in the consideration of ways and means for the organization and management of an International Engineering Congress in connection with the Panama-Pacific Exposition in San Francisco in 1915, which question is now before the governing bodies of the principal National Engineering Societies in the East, it is proposed to raise among the engineers of the Pacific Coast a guarantee fund of $10,000.

It is confidently expected that the sums to be realized by membership fees, by direct appropriation from the National societies or in such other ways as they may determine upon, will serve in very large measure to defray all necessary expenses of the Congress coming under the general heads of (1) Publication, (2) General Publicity, (3) Expenses of Local Committee.

The above proposed fund of $10,000 is however intended to serve as a guarantee to this extent against any shortage in such funds, and to show to the various governing boards that the engineering profession of the Pacific Coast is willing to become responsible for such a share in the necessary expenses of the Congress should the need arise.

There are good grounds for the belief that an assurance of this character coming from the engineers of the Pacific Coast will be a strong factor in determining the attitude of the National Governing Boards toward the proposed Congress.

Subscriptions to this fund are hereby asked under the following conditions.

(1) Subscriptions are not to become effective until a sum equal to or exceeding $10,000 is pledged among the engineers of the Pacific Coast.

(2) Subscriptions are not to become effective until some general plan of organization and management for an Eastneering Congress shall have been approved and adopted by a sufficient number of the governing bodies of the National Engineering Societies, with such further provision for financial backing as shall insure the general success of the movement.

(3) In case the desired local fund of $10,000 is over subscribed, pro rata amounts will be allotted to the various subscribers.

(4) At the close of the Congress and after the payment of all expenses against which the local guarantee fund might be expected to apply, any unexpected balance, with accrued interest, will be returned pro rata to the subscribers.

The plan of subscription will call for payments: one quarter when a Congress is assured, and three-quarters each January 1, 1913, 1914, 1915.

Prof. Wm. F. Durand of Stanford University is chairman of this committee.

SEATTLE ENGINEERS' CLUB ELECTS.

The Engineers' Club of Seattle, which was recently organized, met at a banquet at the Seattle hotel, this week, when the following executive officers were elected: Amos Slater, president; C. W. Willette, vice-president; R. D. Sterling, secretary. The board of directors elected at the same time were W. D. Allen, D. C. Botting, State Inspector of Mines; George W. Evans, P. M. Hale, Ernest B. Hussey, F. A. Hill, James A. Kelly, James H. Linton and P. E. Wright.

TRADE NOTES.

The Pacific Northwest Traction Company, Bellingham, Washington, has ordered an equipment of No. 304 motors and type HL controls from the Westinghouse Electric and Manufacturing Company.

Geo. A. Dow, in the course of a European trip, has obtained the American rights for the manufacture of the Willans-Diesel engine from Willans & Robinson. The Dow-Willans-Diesel Engine Co. will erect a manufacturing plant at Alameda, Cal., adjoining the present plant of the Geo. E. Dow Pumping Engine Company.

The Balfour-Guthrie Cement Company at Bellingham, Wash., whose plant is now rapidly nearing completion, has just concluded an arrangement with the Whatcom County Railway & Light Company for power to operate the plant. Some of this power will come from the Nooksack River plant, while a portion will be purchased from the British Columbia plant at Chilliwack.

The Pacific Portland Cement Company contemplate the installation of the Cottrell dust treating system in the plant at Cement, Cal. A motor generator set consisting of a three-phase motor and single-phase generator will supply single-phase alternating current to a bank of step-up transformers connected to rectifiers which will furnish high voltage direct current for the dust precipitating system.

George J. Henry, 737 Rialto Bldg., S. F., is designing two impulse water wheels for two 150-h.p. hydroelectric units for the Eastern Oregon Light and Power Company. The new generating sets will be added to the present plant, situated on the eastern slope of the Cascade Mountains, which furnishes municipal and commercial lights and power for mining purposes at Baker, Ore. A five-mile wood-stave pipe line conducts water to the plant.

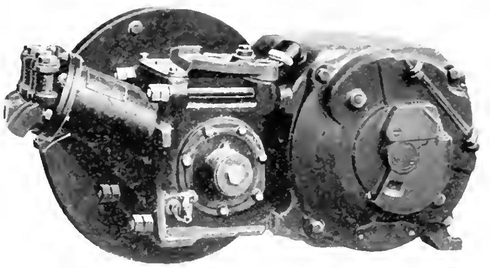
The Pacific Gas and Electric Company has purchased the holdings of the South San Francisco Light and Power Company, including a substation and distributing system. The South San Francisco district of the Pacific Gas and Electric Company has just been formed, in which will be included all of the power lines between Millbrae and the San Francisco county line. Frank P. Edwards, the manager of the old company, will be retained as district manager by the new management.

J. Coughlin & Sons of Vancouver have accepted a contract from the British Columbia Electric Railway Company, Ltd., for raising the high tension wires of the company, crossing the bridge over the Fraser River at New Westminster. At present the wires are 200 feet above the water at the "sag" point and the contractors will increase this height to 225 feet. The work is being done at the request of the New Westminster authorities in the interests of navigation on the river.

INDUSTRIAL

THE WESTINGHOUSE COMBINATION DYNAMOTOR COMPRESSOR.

The Westinghouse combination dynamotor-compressor described herewith is a device for use on 1200 and 1500-volt direct current motor cars and locomotives; it performs the functions of both dynamotor and compressor furnishing half voltage for the operation of the control and lighting circuits, and in addition drives the air compressor when necessary. The dynamotor is connected between trolley and ground, and operates continuously. When the air reservoir pressure falls below a certain predetermined value, the compressor is automatically connected to the dynamotor by a clutch. When the compressor raises the air pressure to a predetermined maximum value, the clutch is automatically disconnected and the compressor stops.



The Westinghouse Dynamotor-Compressor.

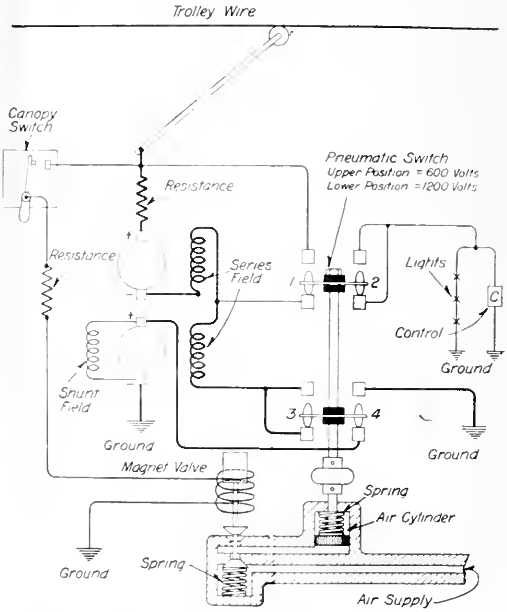
The usual arrangement for 1200 and 1500 volt equipments consists of: (A) a high or low voltage motor for operating the compressor, and (B) a continuously running dynamotor for supplying current at half voltage (600 to 750 volts) for lights and control, and for the low voltage compressor motor, if such is used. The Westinghouse dynamotor-compressor performs the duties for which the two machines were formerly required and as a result, there is a saving of about 900 pounds in the weight of the equipment, and there are fewer parts and only one machine to maintain.

In sections where the trolley voltages is 600 or 750, the dynamotor connections are changed by throwing a canopy switch, so that the dynamotor becomes a compressor motor operating on one winding on half voltages and at normal speed thus driving the air compressor at normal speed. Full air pressure is therefore assured on all interurban and city sections. The straight 1200 volt motor-driven compressors operate at only half speed when on the half voltage sections of a road, and are often incapable of delivering sufficient air to provide for the frequent city stops.

The methods used for lubricating the machine are ingenious and effective. Splash lubrication is used for the compressor cylinders, pinion, gear, clutch and the bearing adjacent to the clutch. The oiling is continuous. The crank case is maintained about half full of oil and the compressor cranks, in splashing through, break up the oil into small drops. Some of it is thrown through a hole in the gear case and onto the gear. The gear carries it over to the pinion which throws a portion on the clutch and a portion on the waste in a lubrication pocket over the adjacent armature shaft bearing. The waste is saturated and the surplus drains back through a duct to the crank case to be used again. The armature shaft bearing adjacent to the commutator is lubricated by means of an oil-well-and-waste arrangement similar to that used on Westinghouse railway motors and therefore only filtered oil is fed to the shaft.

The dynamotor has two separate armature windings on the same core each connected to a commutator. When the dynamotor is connected across 1200 or 1500 volts, the two windings are in series, so that each takes one-half of the trolley voltage. Each armature winding is in series with a field winding. A shunt field winding is connected across the leads of the low voltage armature to maintain the speed approximately constant. The connections are shown in the illustration.

The compressors are of the D-2-L and the D-3-L types and are made by the Westinghouse Air Brake Company, Wilmerding, Pa. They are similar in general design to the compressors that this company has so successfully manufactured many



Connections of Dynamotor and Change-Over Switch.

years for electric railway service. One excellent feature is the placing of the cylinders at an angle, which insures effective splash lubrication and their thorough draining.

A modified type N air pressure governor of the general design that has long been successful in electric railway service operated, indirectly, the dynamotor clutch. There is no electric switch on the governor as an air valve is used instead.

An improved form of the multiple disc clutch, that has given most excellent service on automobiles, is used. It is simple, effective and reliable. When the air-pressure governor, set for some predetermined pressure, acts, it opens a valve admitting air to cylinder adjacent to the clutch. A piston in this cylinder operates against a heavy spring in such a way as to disengage the clutch. When the tank pressure reach a minimum value, the air in the cylinder is automatically released by the governor, the spring closes the clutch and the compressor starts. The clutch is engaged when there is no air pressure so that the reservoir can always be filled.

A switch for changing the dynamotor connections from those for 1500 to those for 750 volts (or from 1200 to 600 volts)

is provided when desired. It simultaneously changes the control and lighting circuit connections from the dynamotor terminals to the trolley. This change-over switch is pneumatically operated and controlled by a canopy switch located in the cab. It consists of a single magnet valve and a pneumatic cylinder similar to those used on Westinghouse switch groups. It carries a double pair of contacts which establish the proper dynamotor and auxiliary circuit connections. Normally, this switch is held in the high-voltage position by a powerful spring. But, when desired, it can be held in low-voltage position by the admission of air to the pneumatic cylinder. In case of a failure of either air or electric power, the switch automatically returns to the high voltage position—the safe one at all times.

NEW TRANSFORMER OIL DRYER AND PURIFIER.

With the extremely high voltages common to the present day transmission systems it is absolutely necessary that the transformer oil be maintained free from moisture and foreign substances which reduce the dielectric strength and render the transformer unable to withstand the heavy stresses it is subjected to. The General Electric Company has developed a transformer oil dryer and purfier which effectively removes water, solid matter, slime, etc., from transformer oil. As a result of exhaustive tests it has been demonstrated that the best method for removing these substances from oil consists in forcing it under high pressure through several layers of dry blotting paper. All solid matter is caught by the first layer of paper while the water is retained in the paper by capillary attraction as the attraction between the paper and water is greater than that between the paper and oil.

For the utilization of this principle specially designed filter presses of several sizes and capacities have been developed, each comprising a special form of press mounted on a base frame of I beams and provided with pump, motor, piping, drip pan and auxiliary devices. The essential portions of the filter consist of a series of alternate flat cast iron plates and frames, the blotting paper being placed between them, and the whole clamped tightly by means of a large screw and lever at one end. Both plates and frames have large cored holes in the lower corners, serving as inlet and outlet for the oil.

The surface of the plates, except for a ½ in. rim round the edge, is grooved or corrugated both vertically and horizontally, on both sides, forming the checkered or so-called "pyramid" surface, which supports the paper and forms channels communicating with the outlet at the corners. This form of surface is more efficient than a single set of corrugations or the use of perforated metal. The oil enters at the lower left-hand corner of the filter, passes through a series of cored holes (A) in the plates and frames and punched holes in the blotting paper and enters and fills in parallel the chambers formed by the frames and plates. It then passes through the blotting paper, along the grooves of the pyramid surface, to the lower right-hand corner of the plate, and then through a series of small holes drilled from the surface of each plate to a cored passageway (B), similar to the inlet.

Since the plates and frames are very thin, and are all connected so that the oil circulates in parallel, large filtering surface and great capacity is obtained in small space; the 12-in. size, containing twenty chambers with forty sets of papers and five layers each, has a total length over the active portion of only 22½ in., yet will filter at the rate of 15 to 30 gals. of oil per minute.

A rotary gear or multistage centrifugal pump is furnished, depending on the size of the filter and the individual requirements of each case. The rotary gear, positive pressure pumps used for the smaller size of filters are extremely simple and compact and are geared to the motors to run at reduced speed. The multistage centrifugal pump of the 12-in. size was especially developed for this purpose.

Any style of motor may be used, geared to the rotary gear positive pressure pumps, or direct connected to the centrifugal pumps.

An electric drying oven has been developed especially for drying the paper. It is substantially built of sheet steel, is provided with thermometer and regulating rheostat and with heating units designed for 110 or 220 volts.

The interior is provided with suspension rods on which the paper may be strung so that it hangs in a vertical position.

The paper should always be saturated with dry oil immediately on removal from the oven, and before it has cooled, as exposure to normal air for a few minutes is sufficient to neutralize the effect of drying.

In addition to its use in purifying transformer oil it is also applied to the treatment of many other liquids as well as heavy viscous compounds, the latter preferably being slightly heated before treatment to reduce their viscosity.

Outfits are now in constant use for the purification of the following materials:

Transformer oil of all kinds, crude petroleum for oil fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating press board and wood, cylinder oil used in certain types of electrical apparatus, and viscous insulating compounds.

NEW CATALOGUES.

Seager Engine Works of Lansing, Mich., have published an attractive catalog on the various features of Olds gasoline engines.

Circular 1165, Westinghouse Fan Motors 1912, is an attractive publication, with a grey and gold cover, just issued by the Westinghouse Electric & Manufacturing Company, describing the new line of fans for the ensuing season.

The U. S. Indestructible Gasket Company of New York has just published a new catalogue in form of seven loose leaflets on high pressure sheet packing, corrugated metal gaskets, manhole gaskets, multiple disc valves, etc.

Westinghouse Metallic Flame Arc Headlight is the title of a small folder No. 4202 illustrating and describing this new type of railway illuminant recently placed on the market by the Westinghouse Electric & Manufacturing Company.

"Street Railway Lamps," is the title of Bulletin 18, recently issued by the engineering department of the National Electric Lamp Association. This bulletin gives complete data or gem and carbon lamps for street railway use, and should be of considerable interest to those connected in any way with street railway work

The Wheeler Condensing & Engineering Company, of Carteret, N. J., whose Pacific Coast representatives are Chas. C. Moore & Company, have issued a valuable hand book of "Steam Tables for Condenser Work," giving pressures below atmosphere expressed in inches of mercury referred to a 30 in. barometer and a discussion of the uses of the mercury column.

The engineering department of the National Electric Lamp Association has recently issued Bulletin No. 19, illustrating and describing the electric luminous radiator, and calling attention to the many ways in which it may be made a convenience in the home. The non-luminous type of radiator is mentioned and comparisons are drawn between the two kinds. A table of data on luminous radiator lamps in regard to size, wattage, voltage, etc., is inserted.

TRADE NOTES.

The Westinghouse Electric and Manufacturing Company has sold the Southern Pacific Company 20 quadruple car equipments for use on its electric railway lines in Alameda County. Westinghouse Type "H. L." controllers will be used

NEWS NOTES

INCORPORATIONS.

LEWISTOWN, MONT.—The Lewistown Electric & Power Company has been incorporated with capitalization of $1,000,000. Wilford J. Johnson heads the company.

LOS ANGELES, CAL.—Lorbeer Electric Supply Company; capital, $25,000; directors, Arthur W. Cleaver, Edward G. Lorbeer, James Irvine and Earl G. Alexander.

TURLOCK, CAL.—A company has been incorporated to be known as the Turlock Gas Company, with a capital stock of $75,000. The company will build and operate a gas plant in this city.

IMPERIAL, CAL.—The Valley Telephone Company has filed articles of incorporation with Holtville as the principal place of business; capital $25,000. O. N. Shaw, J. W. Hart and P. C. Curtis are directors.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed with the County Clerk by the Mount Shasta Power Corporation, capitalized for $10,000,000. It is the purpose of the corporation to develop power on the Pitt River in Shasta county and to distribute and sell electric power and water.

SAN DIEGO, CAL.—The Captain Mutual Water Company has filed articles of incorporation for the purpose of securing a supply of water for irrigation purposes from the watershed of the San Diego River. The capital stock is $90,000. W. R. Andrews, M. B. Christopher and L. Mansur are directors. The office of the company will be located at La Mesa.

SACRAMENTO, CAL.—Articles of incorporation for the San Francisco-Oakland Terminal Power Company, capitalized at $30,000,000 have been filed. The company is to deal in water supply for power purposes, gas, supply, etc. The principal offices will be in San Francisco, and the directors named are F. O. Harrington, L. L. Dunne, Lloyd L. Jackson, L. Abbott, Nat Schmulowitz and C. Cosner, all of San Francisco.

ILLUMINATION.

NAPA, CAL.—A franchise for operation in this city was granted to the Great Western Power Company.

ALAMEDA, CAL.—The City Council has adopted the preliminary bond resolution calling for a $200,000 issue of bonds for electricity, police and fire department improvements, including a new building for the electric light plant and the moving of the plant from the south end of Park street to the corporation yard at the north end of Grand street, fronting on Oakland harbor.

PITTSBURG, CAL.—Van E. Britton, president and chief stockholder in the new Contra Costa Gas Company, organized to supply gas to Martinez, Antioch, Pittsburg and Concord, has obtained an option on a large tract of land in Pittsburg. Work will begin on the $200,000 plant as soon as the weather will permit. Cottages will be erected for the workmen of the plant, and the laying of the pipe lines will begin in a few days.

VANCOUVER, B. C.—The Vancouver Gas Company has recently placed in service its No. 5 gas holder in connection with its system for the British Columbia metropolis. The equipment is a four lift telescopic holder in steel tank and was constructed and erected by Ashmore, Benson, Pease & Company of Stockton-On-Tees, England. The holder is 150 ft. in diameter and the guide towers are 160 feet in height, the capacity of the holder being two million cubic feet of gas. The water tank, which has a capacity of 3,500,000 gallons, is 32 ft. 6 in. in height, and each of the telescopic lifts is 31 ft. 6 in high. The steel plates used range from 7/8 to 3/8 in., about 1000 tons being used in the work. The holder is located in the Grandview section of the city where the company owns a block on which is already located a gas holder of smaller size.

TRANSMISSION.

SEATTLE, WASH.—W. J. Haycox and associates have been granted a 20-year franchise for a power plant.

LOON LAKE, WASH.—John Kulzer, owner of the electric light systems at Springdale and Valley, expects to start work soon on an extension of his system to Loon Lake.

FLORENCE, ORE.—G. G. Bushman has applied for a power and light franchise here. An election will be held March 11 to determine whether the city wants electric light or not.

TULARE, CAL.—C. Rogers has been granted the right to operate a system of masts and poles and wires for the purpose of transmitting electricity for heating, lighting and power purposes in this city.

FLORENCE, ORE.—Geo. M. Miller and James Miller and Joaquin Miller, the poet, have a water power site above Mapleton. They intend establishing a plant and furnishing power and light to nearby towns, including Florence.

PORT TOWNSEND, WASH.—The Key City Light & Power Company will erect a substation of concrete and steel for transforming the high voltage current furnished by the Olympia Power Company. An outlay of between $6000 and $7000 will be made. M. T. Crawford is in charge.

TRANSPORTATION.

SONORA, CAL.—The Sierra & San Francisco Power Company is having repairs made to its flume system at Forebay. The company is planning to run an electric line from the Phoenix lake plant to a point above Strawberry, where the new dam is to be constructed this season.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has submitted to the Vancouver civic authorities plans for the extension of its system by the construction of a line on Nanaimo street from Hastings street to Broadway, a distance of over a mile. The plans call for the construction of the line during the present year.

PETALUMA, CAL.—Twenty-five thousand dollars, which is half of the bonus needed for the construction of the new electric railway north of this city through the Two Rock and Bloomfield valleys, was subscribed at a meeting held this week. The property owners are enthusiastic over the proposed new road and there will be very little trouble in raising the $50,000 needed. The new line will probably go to the coast.

STOCKTON, CAL.—That the Stockton Electric Street Railroad plans to extend its lines in the near future is indicated by the statement that eight carloads of 75-pound T rails are en route here from the Colorado Iron & Fuel Company in Denver and that 3000 tons of additional rails and more cars have been ordered. Three extensions have been discussed—one reaching into Fair Oaks, another for the extension of the El Dorado street line to Oak Park, forming a belt line, and the third out Oak street to the western limits of the city, skirting to the north and re-entering over Poplar street.

SANTA ROSA, CAL.—Surveyors are at work between here and Petaluma surveying a route that will connect Santa Rosa and Petaluma and contiguous territory much more quickly than at present by electricity. It is believed that the extension will be built directly the data is procured. This is the first step toward connecting this county and Marin county with a direct electric railroad to the bay of San Francisco. Another arrangement is contemplated by other capital whereby the Bloomfiled section of this county shall be exploited by electric railroad.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will start the erection of a machine and carshop building, on its grounds between East Seventeenth street and the grounds of the Southern Pacific Company, Center and Mall streets, as soon as the plans have been approved. It will be the third structure erected on these grounds by the street railway company. The two buildings erected by the company, each cover a block and will be used for the construction of the cars. They are one-story buildings, of brick construction and well lighted. The roofs are supported by heavy steel beams.

VANCOUVER, B. C.—The management of the British Columbia Electric Railway Company, Ltd., have announced that the interurban line running northerly from Victoria on Vancouver Island will have its northern terminus at Deep Cove, on the Saanich Inlet. This line is 23 miles in length and from it will run a branch to Union Bay, where Meadlands, formerly owned by the late Hon. R. G. Tatlow, will be developed as a residential and pleasure resort. Work on the line is already well under way, a contract for grading 18 miles having been awarded to Moore & Pethick last year, on which operations have been under way during the winter. The line passes through the center of the Saanich peninsula, a district which needs only tram facilities to assure it of rapid development.

MONTEREY, CAL.—News has been received by the local officials of the Monterey and Pacific Grove Railroad, a lately acquired property of the United Railroads of San Francisco, from the Eastern offices of that company directing that work shall begin immediately on the new line between Monterey and Salinas. The new road, which will be electric, will connect Salinas Valley with Monterey, and it is supposed here that it will be part of an electric system which will run from this county to San Francisco. It is reported that the United Railroads has also acquired the Pajaro Valley Railroad, a narrow gauge steam road, which runs between Salinas and Moss Landing. It is the intention to electrify this road and continue it north through Gilroy, San Jose and San Mateo, and thus complete the line to San Francisco.

PORTLAND, ORE.—M. J. Lee, A. O. Echols and O. M. Lee have filed articles of incorporation with the County Clerk under the name of the Canby-Molalla Railway Company. According to plans of the new company, an electric line will be built from Canby through the southeastern section of Clackamas county. Plans of the organization also include the construction of other lines. The company is organized for only $100,000, but it is understood that Eastern and Walla Walla interests are supporting the enterprise. An auxiliary company has announced plans for constructing an immense dam across the Molalla River above Canby for the storage of water for irrigation and power purposes. It is the ultimate plan of these interests to construct an electric line from Canby into the Tualatin Valley district and thence to Portland

MARYSVILLE, CAL.—The Northern Electric Company has secured quarters here in which to maintain its construction offices while building its new branch railroad to Meridian and Colusa. Bids have been marked for the construction of this road and the contracts are to be awarded March 22. Work is to be commenced immediately thereafter and rushed to completion with all possible speed. The line is to be in operation this year to Meridian, and possibly to Colusa, about 30 miles distant. Particular speed is to be required of the contractors on the section between Yuba City and Meridian, while more time will be allowed on the section from Meridian to Colusa. This end of the line is to be hurried on account of the commencement of the construction work on the Alameda Sugar Company's plant at Meridian. Colusa and Sutter counties will unite with the railroad in the construction of a bridge at Meridian which will span the Sacramento River.

TELEPHONE AND TELEGRAPH.

SAN JOSE, CAL.—The petition of the Valley View Rural Telephone Company for permission to establish pole lines along the county roads in the neighborhood of Valley View was granted.

SAN JOSE, CAL.—The petition of E. D. Franks asking for permission to build a farmers' co-operative telephone line along the county road between Lexington and Los Gatos was granted and the work will be done under the direction of Supervisor Mitchell.

LIVERMORE, CAL.—Cornell & Henry, lessess of Mendenhall Springs, are working up interest in a private telephone line up the Arroyo Mocho. These gentlemen are determined to have a telephone line as far as the springs and they have already secured the promise of a number of farmers and stockmen.

OAKLAND, CAL.—Explaining that the two weeks given in which to prepare a report of the affairs of the corporation as a basis for rate fixing under the provisions contained in the charter had been insufficient, H. C. Brownlee, district commercial superintendent, and Maynard Bailey, commercial manager of the Pacific Telephone & Telegraph Company, have obtained an extension of time of 60 days in which to gather the necessary data.

FRESNO, CAL.—The completion of a commercial telephone line from Clovis, the termination of the Pacific States telephone lines in the valley, to North Fork, on the San Joaquin River, a distance of 40 miles, is announced. The new line gives public wire connections with the Government forest lines running from El Portal on the north to Trimmers Springs on the south, with 100 miles of wires. H. E. Bigelow, the promoter of the new North Fork line, is to build branches to all the mountain resorts within this field.

SEATTLE, WASH.—The temporary order obtained by the city of Seattle, restraining the Pacific Telephone Company, which has absorbed the Independent Telephone Company, from making physical connection of the two telephone systems, has been dissolved by Judge King Dykeman in the Superior Court. The effect of the order is that the work of the linemen in connecting the wires of the two companies can be carried on without molestation by the city and without a permit from the city. The city alleges that it has a $200,000 interest in the poles, wires and conduits of the independent company under the terms of the independent franchise. Physical connection of the two systems had been practically effected when the temporary restraining order was issued, but since that time the operators when asked by subscribers of one system for a connection with the other have replied that they were forbidden by a court order from making it. A proposal for city ownership and operation of a telephone system was adopted at last Tuesday's election by a vote of 32,498 to 18,163. Mayor-elect George F. Cotterill has expressed himself warmly in favor of a municipal telephone system.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, MARCH 23, 1912 | NUMBER 12

Cahuenga Pass Showing New Pacific Electric Railway Grade to Lankershim at Left.

PACIFIC ELECTRIC RAILWAY CONSOLIDATION

By Rudolph W. Van Norden
Member A. I. E. E., A. S. C. E.

Los Angeles has long been known as the center of high development in interurban traction. About a year ago this journal published a description of the properties and operation of the Pacific Electric Railway. While this system was at that time by far the largest and most comprehensive centering in the city of Los Angeles, there were two other systems, each in themselves consolidations of smaller and earlier roads.

The first of these, known as the Los Angeles Pacific Company, operated from its own depot in the city of Los Angeles over two main lines of track to the beach section, lying west of the city and between Santa Monica and Redondo. The other system, known as the Los Angeles and Redondo Railway Company, operated between the city and the town of Redondo over two lines of track. The first named system was standard gauge, the latter 3 ft. 6 in. narrow gauge.

These lines of railway were the spokes which covered and served a quadrant of the great wheel of which Los Angeles City is the hub, the remaining three quadrants being covered by the original lines of the Pacific Electric Railway.

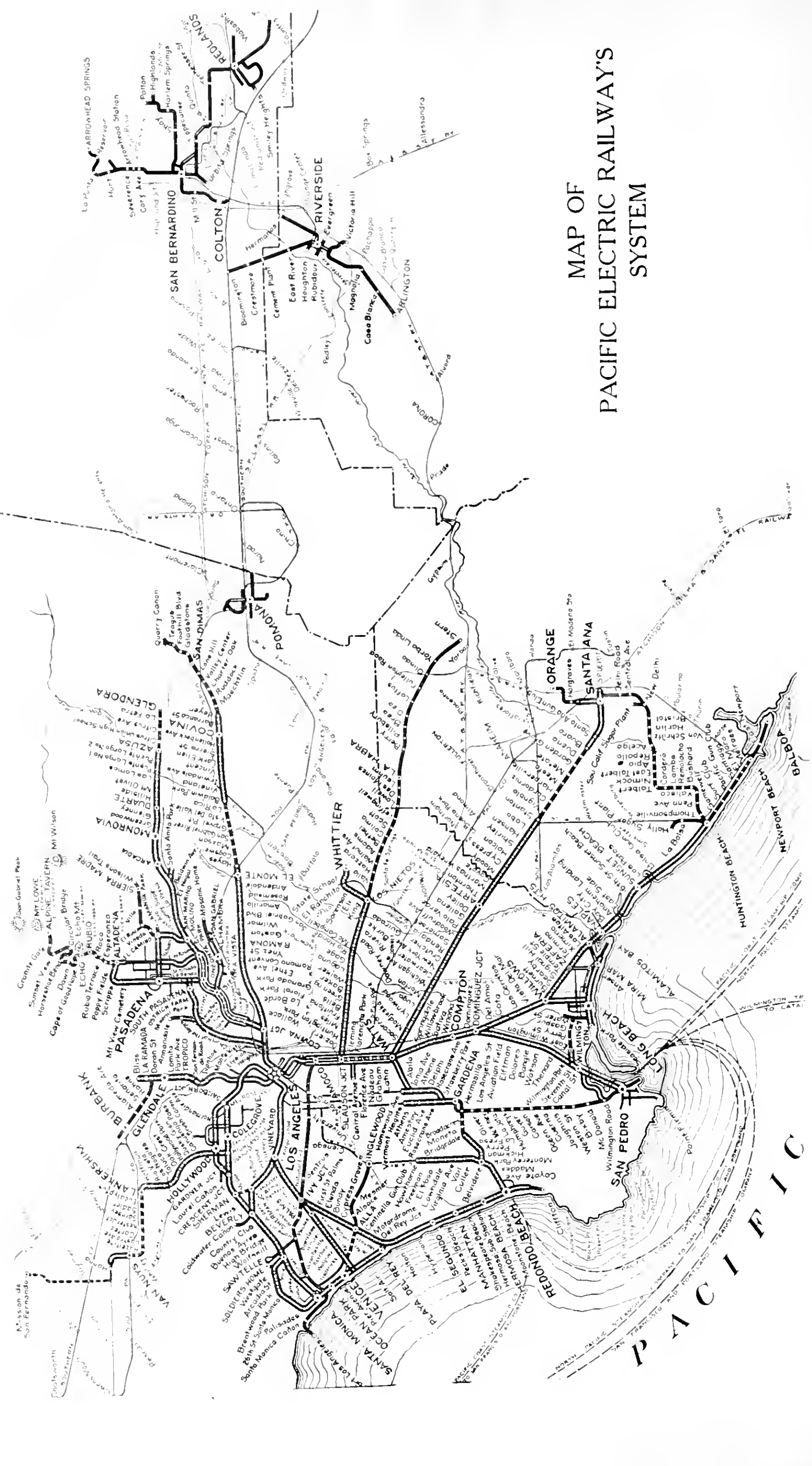
Each of these systems, while ostensibly high speed interurban in character, conducted a large urban business within the congested limits of Los Angeles and in response to this necessity, operated many local street cars. By far the largest part of the street railway business within the congested limits was, however, handled by still another company, the Los Angeles Railway Corporation.

The interests behind all of these roads were more or less uniform and in the fall of 1910 arrangements were made to divide the strictly city street car systems from the long distance interurban lines in such a way that the properties would come under two distinct and separate ownerships and forms of operation. A reorganization was consequently effected, and in February, 1911, the Pacific Electric Railway Company as a holding corporation, came into control of the lines and property of the two interurban systems already mentioned, the Los Angeles Pacific and the Los Angeles and Redondo.

That section of all three companies which handled local street railway business became the property of the Los Angeles Railway Corporation.

Some changes were necessary in the original Pacific Electric system to comply with this consolidation. The first of these was the abolishing of the Los Angeles City Division and the creating of the new Western Division.

The original narrow gauge line operated between Los Angeles and San Pedro by the way of Gardena was divided, the section between the city and Home-



MAP OF
PACIFIC ELECTRIC RAILWAY'S
SYSTEM

ward becoming the property of the city corporation, while the section between Homeward passing through Gardena, to San Pedro, a distance of 14.52 miles, has been broad gauged, together with that part of the Los Angeles and Redondo Gardena line between Gardena and Redondo, and that part of the Inglewood line between Hawthorne and Belvidere, a total distance of about 15 miles.

A new line 2.59 miles long, was built connecting Watts and Homeward, thus creating a direct line from the Sixth and Main Streets' depot, over the four track trunk line of the Southern Division and from there directly to Redondo, a distance of 20.9 miles, this section becoming a part of the Southern Division.

The lines and system of the Los Angeles Pacific, together with the Glendale line, formerly integral with the Angeles City division and the recently electrified Southern Pacific freight line between Amoco Junction and Santa Monica pier, are now known as the Western Division.

Soon after the consolidation, real estate activities in the San Fernando Valley, in the creation of the towns of Lankershim and the Van Nuys, induced the company to build a new line from Hollywood through the Cahuenga Pass, paralleling the El Camino Real, or King's Highway, the mission road of California, through Lankershim, thence to Van Nuys and finally ending at the San Fernando Mission.

Each of the three divisions, the Northern, Southern and Western, are like great fans, or better, like a tree with its trunk and branches. The Northern and Southern Divisions meet and commence at the Pacific Electric Building at Sixth and Main streets in Los Angeles, and here is the main depot and the nucleus of the entire system from which more trains are daily dispatched than from any five similar depots in the United States.

Western Division.

Cars and trains for the Western Division depart from the station at Fourth and Hill streets. This arrangement is at present necessary, due to the congested condition of streets in the city, but it is eventually proposed to so arrange the outlets from the main depot that all interurban trains may be dispatched from that point. This, however, is a serious problem which will necessitate a great outlay of money and much engineering activity.

This division consists of two main double track lines, leaving the Fourth and Hill Streets' station in opposite directions. The first of these, which was one of the early interurban lines built out of Los Angeles, and known as the Colegrove line, follows South Hill street, passing through two double track concrete lined tunnels, having respective lengths of 545.78 and 975.44 feet, then a northwesterly direction, following one of the many wide boulevards for which this city is famous, passing through the suburb of Colegrove, thence changing in direction to the southwest paralleling the Santa Monica mountains, passing through Sherman, Beverly and Sawtelle, to the city of Santa Monica. There is a loop in this line which passes

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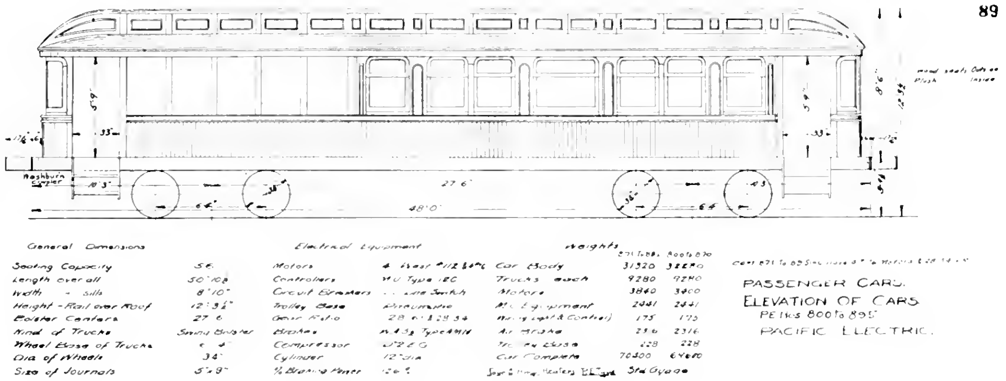

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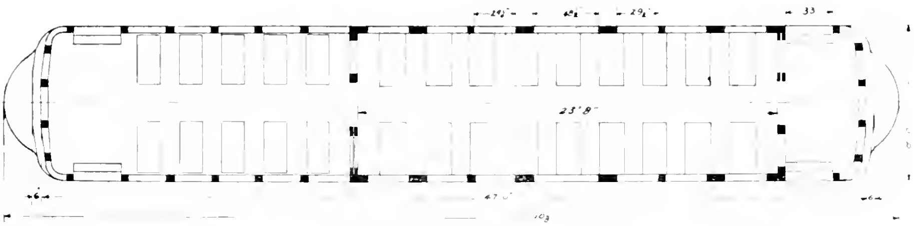


Pacific Electric Standard Interurban Car.

Lankershim Line During Construction Through Cahuenga Pass.

through the beautiful suburb of Hollywood joining the Colegrove line at Crescent Junction. There is another loop which leaves the line at Sawtelle, passing the Soldiers' Home and joining the line again at Santa Monica.

The other main line leaving Los Angeles follows South Hill street southward for several blocks and then a westerly direction until the edge of the congested portion of the city is reached at Vineyard, when it passes onto a right-of-way owned by the company. This is known as the Venice Short Line and was built for the purpose of creating a rapid service between Los Angeles and the beaches. This road passes through the suburb of Palms and thence to Venice. A cross line is operated between Vineyard and Beverly and a branch is operated between Palms and Playa del Rey, one of the sea-side resorts. There are a number of other short branches operating more or less local services.

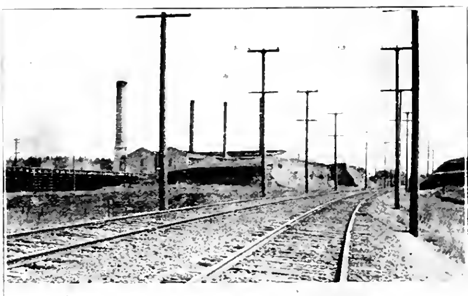
These various lines are connected by an ocean shore line between Santa Monica and Redondo, passing through the famous ocean resorts of Ocean Park, Venice, Playa del Rey and Manhattan. All of the main and cross lines are double tracked.

These beach resorts are older and perhaps better known than the various resorts south of San Pedro, reached by the Southern Division. An enormous amount of money has been expended for bath houses and amusement places of every conceivable order. Thousands of comfortable bungalows and cottages line the well laid out and paved streets close to the beach and every form of amusement and entertainment is in store for the tourist or the resident.

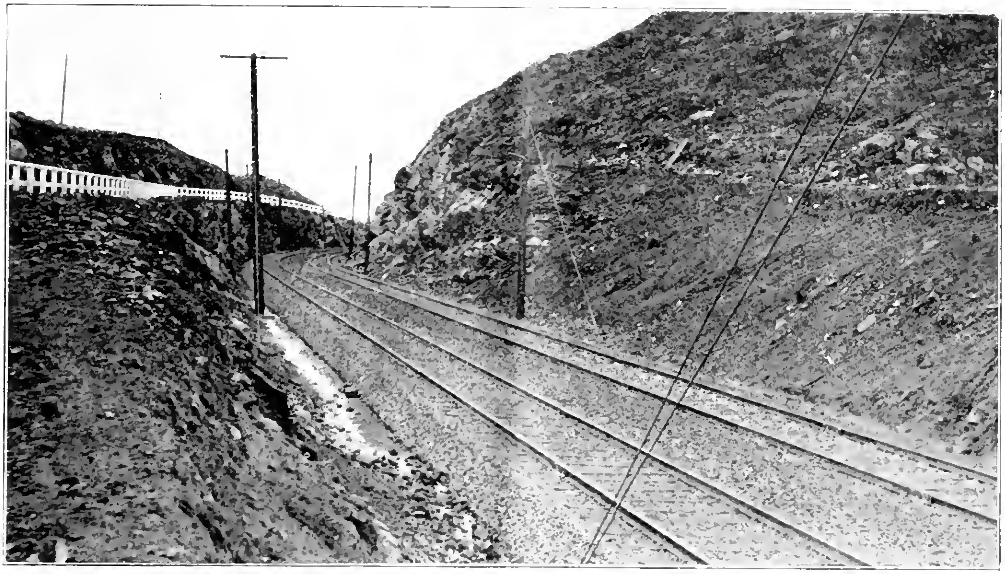
Between Ocean Park and Playa del Rey there are a number of lagoons naturally formed, and these have been wonderfully developed in imitation of the canals, bridges and palaces of ancient Venice.

In each of these places are every accommodation for surf and indoor bathing, furnished by large and well equipped bath houses. At Redondo is one of the largest bath houses in the world with is endless variety of amusement and restaurant features.

The new branch recently constructed from Hollywood into the San Fernando Valley is a fine example

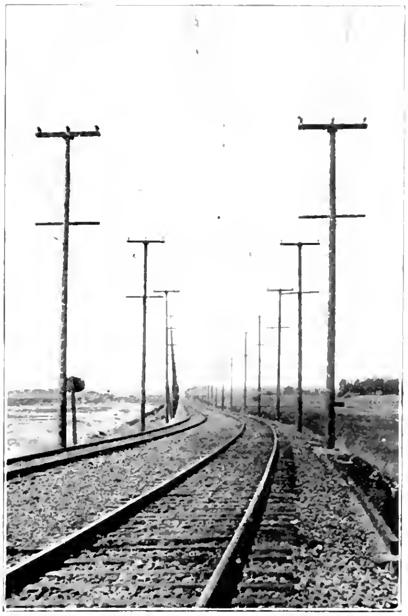


Venice Short Line and Vineyard Power House.
New Line Between Watts and Homeward.



Big Cut at Summit of Cahuenga Pass.

of modern interurban construction. In taking its course through the Cahuenga Pass it was necessary to make a number of very heavy cuts and fills. The largest cut, at the summit, has a length of 950 ft.



Catenary Trolley Along Venice Short Line.

with an average depth of 26 ft., and it was necessary to remove 59,000 cubic yards of rock. This was a particularly treacherous undertaking, as the rock is seamy and extremely difficult to blast. The other cuts, while similar, represented much difficult work, but the resulting grade and alignment furnish a splendid feat of engineering. The entire line is ballasted with broken rock, there being 4700 yards per double track mile. The Pacific Electric standard of construction is maintained throughout, the rails being A. S. C. E. common standard 70 lbs. per yard, the ties of redwood, 16 per 30 foot rail. The grade through the pass is 5 per cent compensated from bottom to summit on the south approach and slightly less on the north approach. There are four trestle bridges, the first crossing the Los Angeles River, being 700 ft. long, double track, and having an average height above the bed of the river of 24 ft.

The second trestle crosses Pecina Wash and is 500 ft. long, also double track. The remaining two trestles are single track, the first being 900 ft. and the second 450 ft. long. These trestles are erected on eight pile bents and follow Southern Pacific standard specifications. The total length of this line under operation is 11.65 miles, of which there are about equal lengths of single and double track road bed. The remainder of the line will soon be ready for regular operation.

A catenary trolley construction is used throughout this branch. It is supported through the Cahuenga Pass with double pole span construction, the poles being 35 ft. long. In the San Fernando Valley the construction is centre pole and bracketed, of standard Electric pattern, the poles being 45 ft. long and carrying a three-phase, 15,000 volt transmission circuit at the top.

Car Handling System.

The economical handling of cars so that there may be system in the repairing work and at the same time a maximum duty from each car is a complex problem. It is the policy of the company to overhaul every car within a certain definite period. It is neces-

sary, to obtain maximum efficiency, that the car leave the shop in perfect condition. It is also necessary that it be kept in perfect condition in order that high-grade service may be maintained. The system must,

Class No. or Serial	Total No. of Cars	Av. No. Cars per Mo.	1st Mo	2nd Mo	3rd Mo	4th Mo	5th Mo	6th Mo	7th Mo	8th Mo	9th Mo	10th Mo	11th Mo	12th Mo	13th Mo	14th Mo	15th Mo	16th Mo	17th Mo	18th Mo
0	12	67	1	1	0	1	1	0	[illegible]		0		1	[illegible]	1	1	0	1	1	0
1-99	53	294	2	3	3	3	3	3	3	3	2	3	3	3	2	[illegible]	3	3	3	3
100	37	206	3	2	2	2	2	2	2	2	2	2	2	[illegible]	2	[illegible]	2	2	2	2
200	29	55	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5
400	97	482	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5
500	100	555	5	6	5	6	5	6	5	6	5	6	5	6	6	5	6	5	6	6
700	47	261	2	3	3	2	3	3	2	3	3	2	2	3	2	3	3	3	2	[illegible]
800	100	555	6	5	6	6	5	6	6	5	6	6	5	6	5	6	5	6	5	5
900	74	33	1	1			1	1					2		2		2	2	2	2
1300	19	106	2	1	1	1	1	1	1	1	1	1	1			1			1	1
1400	36	200	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1500	45	25	2	2	3	3	2	3	2	2	3	2	2	[illegible]	2	3	3	3	2	3
1600	1	06	0	0	0	0	1	0	[illegible]	0	0	0	[illegible]	0	0	0	0	0	0	0
Service Cars	1	6	1	1	1	3	3	1		1	0	0		1		[illegible]	0	1	1	0
Total	671	3727	38	37	38	37	37	38	37	37	37	37	37	38	37	37	37	38	37	37

Schedule for Overhauling Passenger and Freight Motive Equipment.

therefore, be comprehensive and well organized. All minor repairs, including the changing of wheels and armatures are made by the division foreman of the division on which the car is operated. For this reason he will not accept a car on his division until he is absolutely certain it is delivered to him from the shop, in perfect condition. As it is his duty to maintain the car in this condition he cannot return it for repairs until he has proof that the repair necessary is beyond the capabilities of the equipment with which he is provided. He, therefore, is held responsible for the condition of cars up to the point where the car actually needs to be returned to the shop. After a car has been in service, however, for a stated length of time it is returned to the shop for general overhauling.

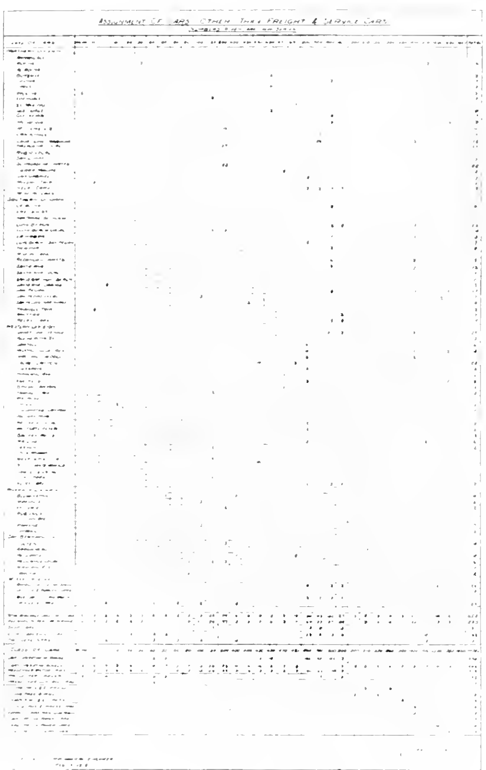


Chart Showing Car Assignment.

A number of simple and effective office methods are used in connection with the mechanical engineering department. For instance, if there is a failure which requires the attention of the mechanical engineer, and in a system operated with the extreme high load factor of this system, such failure requires immediate attention; instead of following ordinary practice of issuing an order to a division foreman which he may not receive for several hours and which must be properly filed in the general company files, the notice of failure, immediately upon receipt is acted upon by the mechanical engineer. He telephones his order to the stenographer in the office of the foreman interested. The stenographer takes down the order, immediately handing one copy to the foreman, returning a copy to the mechanical engineer and sending a third copy for the general files. This accomplishes the desired purpose in the shortest limit of time without a long system of red tape, but at the same time keeping all records in perfect condition.

The average of failures for this system is one for each twenty-five to thirty thousand miles per car, or less than one per cent. A standard form showing in a vertical column the various routes and in the horizontal the various classes of cars used, enables each foreman to know the number and type of cars and the distribution over the system. Another simple form shows at a glance the time that every car has been in or out of the shop and gives both the master mechanic and the division foreman an instant knowledge of the probable condition of every car.

The total mileage of track operated in the three divisions approaches the one thousand mile mark and will soon pass this figure. This mileage is as follows:

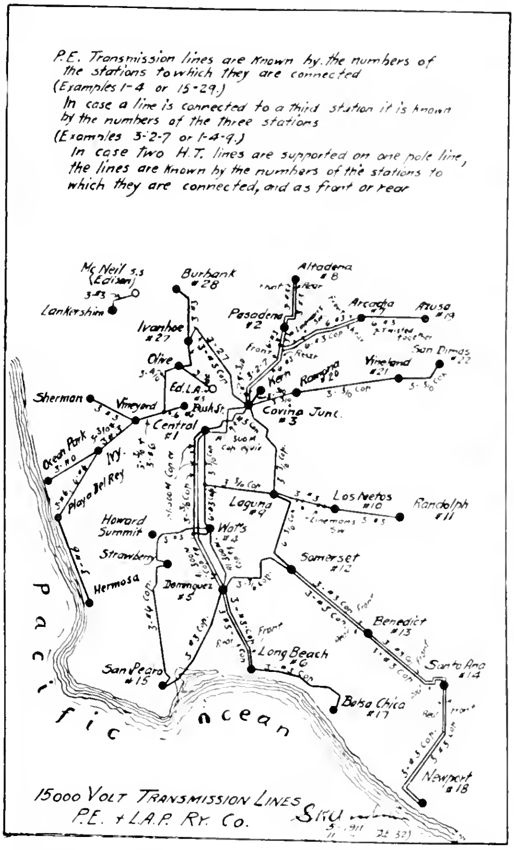
		Single Track Equivalent
Single track	219.88	219.88
Double track	253.61	507.22
Four-track	11.46	45.84
Joint track	5.37	10.74
Miscellaneous	99.96	99.96
S. P. Amoco-Santa Monica	7.8	15.6
		899.24

Added Equipment.

The recent consolidation has added a larger equipment which differs somewhat from former Pacific Electric standards. The newer cars of the Los Angeles Pacific Company are quite similar to those already in operation. A number of radical changes have been made with some of the older cars, in the lengthening by 8 ft. of the car body, and equipping with new trucks, General Electric motors and Type M multiple unit control. Fifty cars which originally were operated on the narrow gauge system were reconstructed by building new trucks for standard gauge, using the old motors and equipments.

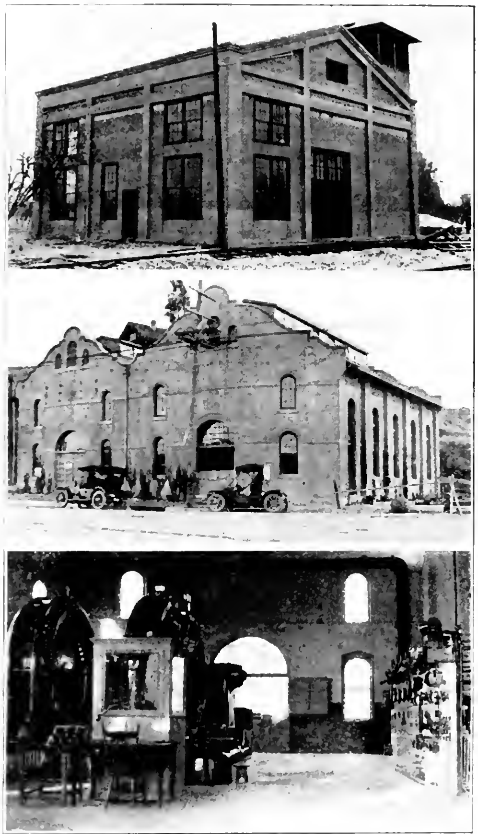
Added Substations.

There are now 37 substations in active operation. Two portable substations which may be shunted, and placed in service at short notice at any point on the network where it may be necessary to centralize a large amount of power, and two central stations in operation in Los Angeles. The substations and electric operation are under the supervision of the electrical engineer, Mr. S. H. Anderson, one of the department heads, who has been with the system since its start.



A late style of motor generator, of which there have been a number installed within the last year is of 1000 kilowatts capacity. The motor is of the synchronous type, but is provided with a squirrel-cage winding inserted in the pole faces, to allow starting as an induction motor. The generator is 6 pole with interpoles and is compounded to deliver the same voltage when at full load as at no load. The speed is 600 r.p.m. and there are but two bearings to the set. These sets were furnished by the General Electric Company.

A new substation approaching completion at Lankershim is quite similar to the Covina Junction station in its interior arrangements. It is, however, somewhat smaller than that station and will be provided with two 600 kilowatt General Electric motor-generator sets. This substation building is square, has six inch concrete walls and a concrete hip roof. While plain in appearance it is not unpleasing and is convenient and well designed.



Lankershim Substation.
Olive Substation.
Interior Olive Substation.

Power for the Western Division is supplied by the Los Angeles Edison Company to the various substations. The steam generating plant at Vineyard is operated as an auxiliary in a manner similar to the Los Angeles Central Station No. 1, by the Edison Company.

A "SEATTLE COMPETITION."

A spirited competition is on among the [illegible] of the Denver Company Section of the N. E. L. A., with a trip to the Seattle Convention as the goal. The plan embodies the "point system" and the two candidates gaining the largest number of points during the four months of the contest will be declared the winners and will have the trip to Seattle with expenses paid.

The sources through which credit may be gained include writing or discussing papers and questions at section meetings, gaining new members and regularity of attendance, as well as suggestions for the betterment of the section.

ECONOMIC CONDITIONS GOVERNING SPAN LENGTH.

BY R. S. BROWN.

The cost per mile of a transmission line, constructed over level country, is, for a given size of wire, determined by the number of poles or towers per mile. This would seem to indicate, as the criterion of cheapness, the use of long spans and few supports. Such construction, however, has the disadvantage that it requires supports of great height, since the sag for a given tension, is proportional to the square of the span length. The cost of a pole or tower capable of withstanding a given strain increases rapidly with the height due to the fact that the lateral dimensions must be increased along with the height. In the case of long poles the cost increases because of the scarcity of such timber.

If c be the cost in dollars of one complete structure, including insulators, transportation, erection, etc., and n the number of supports per mile, the total cost per mile will be, $D = cn$. If L be the length of span,

$$L = \frac{5280}{n}$$

and

$$D = 5280 \frac{c}{L}$$

Let,

h = the height of support.
g = minimum allowable ground clearance.
s_0 = maximum sag of conductor.
k = a constant.

Then,

$$s_0 = kL^2$$
$$h = g + s_0$$
$$L = \frac{1}{\sqrt{k}} \sqrt{h-g}$$
$$D = 5280 \sqrt{k} \frac{c}{\sqrt{h-g}}$$

For D to be a minimum,

$$\frac{dD}{dh} = 0,$$

hence,

$$\frac{dc}{dh} \sqrt{h-g} - \frac{c}{2\sqrt{h-g}} = 0.$$
$$h - g = \frac{c}{2} \frac{dh}{dc}$$
$$s_0 = \frac{c}{2} \frac{dh}{dc}$$

That is, for a given size of conductor, the cost per mile of a transmission line will be a minimum when the maximum sag of the conductor is equal to one-half the cost of a support multiplied by the rate of change of height with cost.

This relation may be applied graphically by plotting the relation between c and h for supports of specified strength and from this curve plotting the function $g + \frac{c}{2} \frac{dh}{dc}$. The intersection of these two curves will give the proper value of h.

h may be found analytically as follows. Let c_1 and c_2 be the costs of two supports of heights h_1 and h_2 respectively. Assuming c to be the average of c_1 and c_2,

$$h = \frac{c_1 + c_2}{4} \frac{h_2 - h_1}{c_2 - c_1} + g$$

If the value of h as found from this equation falls between h_1 and h_2 it is the proper height of support, if it does not try new values of c_1, c_2, h_1, h_2, until it does, in which h_1 and h_2 should not differ by more than about five feet.

After the value of s_0 is found by the above method the length of span is found from the relation,

$$L^2 = \frac{2Ts}{3rd}$$

Where,

d = the density of the conductor metal, lbs. per cu. in.
T = tension in the conductor, lbs. per sq. in.
r = ratio of the weight of one foot of wire with maximum loading of ice, to the weight of one foot of bare wire.

If the maximum sag occurs when the weather is coldest and the ice loading the heaviest,

$$L = \sqrt{\frac{2T_0 s_0}{3rd}}$$

T_0 being the maximum allowable stress in the metal.

Using this value of L, find what the sag will be in the hottest weather with no loading. If this sag exceeds the cold weather sag find by trial a value of L which will give sag s_0 in hottest weather and will stress the wire to tension T_0 in coldest weather with loading r.

Example: If a 40 ft. steel tower costs $350, complete with insulators, and a 45 ft. tower of the same strength costs $390, what is the most economical height and span length? $g = 20$ ft.

$$s_0 = \frac{740}{4} \frac{5}{40} = 23 \text{ ft.} \quad h = 20 + 23 = 43 \text{ ft.}$$

Let

$$T_0 = 30000 \quad r = 2 \quad d = .321$$

Hence,

$$L = 845 \text{ ft.}$$

The sag in this length span after a rise in temperature of 100 deg. F. and without loading ($r = 1$) will be 13 ft., which is less than the cold weather sag, 23 ft., therefore, 845 ft. is the length of span which will give the minimum cost of line.

POLE TREATING.

The San Joaquin Light & Power Company has found that untreated western yellow pine poles showed completely rotted stubs after 27 months' service on their line. Of those given a brush treatment with creosite 27 per cent showed signs of decay and of those brush treated with carbolinium 29 per cent showed signs of decay; of those treated with crude oil 45 per cent showed slight signs of decay. About 28 per cent of those treated with zinc chloride showed attack by decay. About 50 per cent of the entire number of poles tested were treated with creosote by the open tank method and these were found to be perfectly sound, showing no signs of decay whatever.

PRODUCING PROFITS—"VELVET."

BY ROSS B. MATEER, POWER EXPERT.

The installation of an elaborate sign, the contracting for tungsten street lighting, the outlining of a cornice, or an entire building, appeals more to the central station and its officers than a good day load. Go to many cities and the first outburst of enthusiasm over local conditions comes from the local officials when they mention lighting effects, signs, etc. Should you exhibit an interest in lighting conditions, you are requested to view the city by "artificial light." Your day is passed in viewing the offices and in conversation with the officials; the evening is spent in observing the "light." Some places you note are so lavishly lighted as to dazzle, yet near by is found a store or building almost dark. You pass from street to street, from building to building and find the same conditions, one dazzling, the next dark.

The next day you discuss revenue, then the gross and finally the net profits. When profit is mentioned, the analytical mind tries to determine what the profits are and whence derived. Is it the lavish lighting, the spectacular effects that are productive of an increased peak load that yields profit large profit? A synonym for profit is "velvet." Where would one naturally look for the "velvet"? Surely not in increasing the peak business, but in increasing the daylight load—the power end of the plant.

No central station man who watches the earnings of his company can ignore the power end. He must admit to himself, though he does not acknowledge to others, that the profits of the company are produced not from the lavish display lighting, the beautifully lighted windows at night, but by the electric motor installed now for the operation of every industry. The motor, small or large, which drives the line shafting, or the individual motor-driven machine operated usually from seven in the morning until six at night, and often running 24 hours a day.

Why is the power revenue the "velvet?" A moment's thought will show that the central station must be ready to supply electricity 24 hours a day and sufficient current for light at the convenience of the customer. To be ready to supply light, the boilers must be fired, thereby consuming coal in large quantities, for the engine or turbine must be in operation, and in addition the switchboard attendants must be on duty. The expense is the same as when operating through a "night peak." The expense being the same, is it not evident that all the motor load secured that is in operation during the day, leads to an increase in the plant efficiency. Not only does this equal the expense of maintaining steam, but yields a handsome profit. Charge all the plant expenses to the lighting end and all the day power load is "rich velvet." Charge the daylight expenses of the plant to power and the incandescent expense is lightened. Upon the power business is placed much of the support of the incandescent and still the power business yields a good profit—"velvet."

"Velvet"—How Secured.

Central stations state they employ power salesmen, those who use the sharp pencil and the pad and can figure how much cheaper a customer can operate by the use of central station "juice." Power salesmen are good, but the central stations need more, they need power engineers. A power engineer should be competent to sell an electric appliance, a gas range, in fact, any commodity directly handled by his company. He should be a general man, conversant with all sides of the central station business, and his knowledge, together with a technical and practical training, results in power engineers—not power salesmen.

The power engineer is the general manager of the future. The banker, the accountant, the representatives of large interests, though head of the power companies now, will be replaced in the future by the power engineer, for he is the practical man, the worker, the one working directly for the stockholders' interest

Often it is not by pad and pencil and how much a power engineer can save a customer over present forms of power, but how a rearrangement of factory and its machinery, how the output may be increased by improved machinery and systems of operation; how much convenience in operation appeals to a prospective customer; and then how to secure the business without figuring dollars and cents.

The power engineer is a general man. He can figure on heat and its producing fuels; he has a good knowledge of effective, not wasteful illumination; sign and display lighting, effectively applied, is not new to him; the general saleswork of his company he has learned; a knowledge of accounts and how kept is his. This, with a technical training and practical experience, gives us today the man who produces the profit—the "velvet."

NAVY WIRELESS PLANS.

The U. S. Navy Department proposes to erect a high-powered wireless telegraph station on the California Coast for communication with similar stations on the Pacific, namely, one at North Head, opposite Astoria, one at Cordova, Alaska, and one at Unalga, near Unalaska. This California station is one of a chain across the Pacific Ocean, the others to be located at Pearl Harbor, Guam, Luzon, Tuituila and the Philippines, as well as one at the Panama Canal.

The location of the California station has not yet been determined and will depend upon the best facilities for wireless work offered by various localities. The Navy Department has been unable to buy land in the past as special authority is required from Congress.

It is being actively urged that this would make a desirable attraction for the Panama-Pacific Exposition if located at San Francisco, especially if operated in conjunction with the proposed Memorial Tower. The best site appears to be in Golden Gate Park near the ocean boulevard. If this land could be deeded to the Navy Department and if a 600 ft. tower could be erected by the exposition authorities or the marine and business interests the Navy would install the equipment.

POWER COMPUTATION OF ROTARY AIR COMPRESSORS.[1]

BY ROBERT SIBLEY

The rapid rise of the steam turbine has led to much thought and study in application of the rotative idea to other reciprocating apparatus. The subject of centrifugal operation of pumps has received attention in a marked degree and has been developed to a high stage of efficiency. Since these pumps operate at high speeds they invariably occupy much less space and consequently have received great favor in recent installations.

The subject of air compression by means of centrifugal force has, within the last two or three years, received marked attention and the results produced have been most flattering to the inventors. In the March issue of the General Electric Review appears a paper by Dr. Louis C. Loewenstein on Centrifugal Compressors. The theory is there developed in a masterly manner but for the purpose of stepping this information still further down to the "primer" idea let us go into the elementary derivation of the equations of the centrifugal pump compressor.

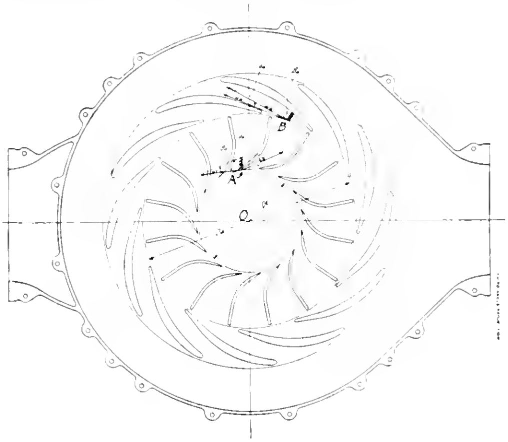


Fig. 1. Rotary Air Compressor.

In Fig. 1 is seen a diagramatic representation of the rotary compressor. The air enters from the center at the point A and is thrown outwardly at the point B due to centrifugal force. It is customary to allow this air to enter radially. The instant, however, the air reaches the rotating portions, this entering velocity w_i decomposes into two components, one component u_e traveling with the rotation of the wheel and the other component v_e along the rotating vane.

In elementary mechanics we learn that energy is never destroyed, consequently the energy of each pound of air at A must be equal to the energy of each pound of air at B, although the proportions of kinetic energy or energy of motion may be larger in one case than in the other. We shall expect then in considering the sum of the kinetic and potential energy that this sum shall be the same at either point, where allowance is made for added velocity energy at B due to the larger rotative value at B. We have previously learned in the study of thermodynamics that the product of pressure times the specific volume or pv represents the eternal energy of a gas under constant pressure, or in other words the energy necessary to force a given volume of air v into a reservoir under pressure of p lb. per sq. ft.

Let us suppose that the air is drawn in at a pressure and volume of p_1 and v_1 as graphically shown at A, in Fig. 2. After passing through the rotating vanes the air becomes compressed to a pressure and volume of p_2 v_2 shown at B. In the Twelfth Lecture of this series appearing in this Journal, November 25, 1911, we found that the work in ft. lb. necessary to compress a gas from A to B is equal to

$$W = \frac{R}{1-n}(T_1 - T_2) = \frac{p_2 v_2 - p_1 v_1}{n-1}$$

Now due to the air entering the rotating impeller under a pressure and volume of p_1 v_1, we really are aided in rotating the impeller by an amount of work equal to $p_1 v_1$ ft. lb. or the negative work required to force air against the entering pressure. On the other hand in order to deliver the compressed air into the reservoir which is at a pressure and volume of p_2 and v_2, a positive amount of energy $p_2 v_2$ ft. lb. is required. Hence the net work required to force each pound of air through the impeller and deliver it into the reservoir is

$$W = \frac{p_2 v_2 - p_1 v_1}{n-1} + p_2 v_2 - p_1 v_1$$

$$= \frac{n}{n-1}(p_2 v_2 - p_1 v_1)$$

$$= \frac{n p_1 v_1}{n-1}\left(\frac{p_2 v_2}{p_1 v_1} - 1\right)$$

and since we have previously found that a perfect gas obeys the law $p_1 v_1^n = p_2 v_2^n$, we have

$$\frac{v_2}{v_1} = \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}} = \left(\frac{p_2}{p_1}\right)^{-\frac{1}{n}}$$

$$\text{or } W = \frac{p_1 v_1}{k}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

$$\therefore \frac{p_2}{p_1} = \left(1 + k\frac{W}{p_1 v_1}\right)^k \text{ ---------------------- (1)}$$

in which k is equal to $\dfrac{n-1}{n}$.

Again it is often desired to obtain the average, or mean effective pressure of the air undergoing compression. The mean effective pressure is such a constant pressure as would be necessary to maintain throughout the compression assuming that the specific volume remained constant. Hence, if p is the mean effective pressure, we have at once

$$p v_1 = W$$

but from the value of W above deduced we, then, have

$$p v_1 = k\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

$$\therefore p = \frac{k}{v_1}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

[1]This paper comprises the Twenty-fourth Lecture of a series appearing in these columns entitled Primer of Applied Thermodynamics.

It is often convenient to plot a curve from which values of p may be readily taken for varying values of p_2 and vice versa. When this is once accomplished applications of equation (1) are materially simplified.

As air enters at A as shown in Fig. 3, it receives a total kinetic energy from the rotating impeller equal to $\frac{u_e^2}{2g}$ ft. lb. and when this pound of air arrives at B its total kinetic energy is evidently $\frac{u_a^2}{2g}$.

It seems that commercial designers prefer to have the air enter the impeller radially at A and leave with a relative velocity at B directed radially outward. Let us call b_e the angle between the entering relative velocity v_e and u_e, also call d_e the angle between the entering velocity w_e and the rotating velocity u_e. Let the subscripts a indicate at the point B similar angular and velocity relationships. Looking now at the point A, since the angle d_e is a right angle, we have at once

$$v_e^2 = u_e^2 + w_e^2$$

and again since at B the angle b_a is a right angle we have

$$w_a^2 = u_a^2 + v_a^2$$

If the outlet or inlet of this rotary compressor were closed for an instant, it is evident that, since there would be no movement of air, but simply a pressure at B in amount equal to the kinetic energy

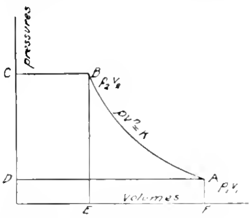


Fig. 2. Indicator Card for Rotary Air Compressor.

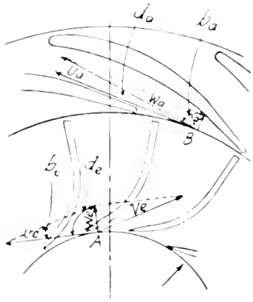


Fig. 3. Diagram of Velocities in Rotary Air Compressor.

of the air at that point, a pressure energy equal to $\frac{u_a^2}{2g}$ would be exerted. The instant, however, that the inlet is opened and a movement of air takes place, this pressure or potential energy would certainly be reduced by an amount equal to the kinetic energy of the air set in motion along the impeller blades, namely $\frac{v_a^2}{2g}$. Hence the potential energy of each pound of air delivered at point B is

$$\frac{u_a^2 - v_a^2}{2g}$$

Since, in addition to this potential energy, there is a movement of the air, evidently if we can convert eventually this additional kinetic energy into pressure or potential energy we can raise the pressure, or in other words, compress the air to even a much higher degree. This can be accomplished by properly guiding the air through stationary vanes after it has left the rotating impeller. By referring to the diagram it is seen that the absolute velocity of the air as it leaves the rotating impeller is w_a feet per second. Hence there is represented in each pound of air a kinetic energy equal to $\frac{w_a^2}{2g}$. If, then, we can recover this entire energy of motion and convert it into energy of pressure, we shall have a total pressure energy given to each pound of air, due to our rotary compressor, equal to

$$W = \frac{u_a^2 - v_a^2 + w_a^2}{2g} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Substituting our value for w_a^2 which we have found to be equal to $u_a^2 + v_a^2$, we now have as the total energy possible to absorb into pressure or potential energy

$$W = \frac{u_a^2 - v_a^2}{2g} + \frac{u_a^2 + v_a^2}{2g} = \frac{u_a^2}{2g} \quad \ldots\ldots\ldots (3)$$

Of course, it is impossible to recover this entire pressure energy. The ratio of the actual pressure energy obtained or in other words the ratio of the actual energy represented in the compressed air to that represented in our theoretic formula is called hydraulic efficiency, while the ratio of the actual energy represented in the compressed air to that required to be delivered at the shaft of the impeller in order to operate it is called the shaft efficiency.

In the multi-stage compressors, a series of these passages, one after the other, are passed through by the air, and, after passing through each series, the air is proportionally compressed to a high degree. If N represents the number of impellers or stages in series, the following energy should be absorbed by each pound of air from the rotating impeller.

$$W = e\,N = \frac{u_a^2}{g} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Substituting the value of W in equation (1) we have

$$\frac{p_2}{p_1} = \left[1 + \frac{k-1}{k}\,\frac{e\,N\,u_a^2}{g\,p_1\,v_1}\right]^{\frac{k}{k-1}} \quad \ldots\ldots (5)$$

This formula not only applies for air but also for carbon dioxide, nitrogen, hydrogen or any of the other so-called perfect gases.

Work is the product of force and distance through which the force acts. Let a be the net area in sq. ft. of the outlets of the impeller and v the velocity of the air in ft. per sec. leaving the impeller. Since p_2 lb. represents the pressure over each sq. ft., the total pressure is $p_2 a$ lb. This force acts through a distance of v ft. per second. Hence there are $p_2 av$ ft. lb. of work being done every second. But (av) is the

quantity Q of air delivered each second, and, since 550 ft. lb. per second are equal to one horsepower, we have

$$\text{H.P.} = \frac{(p_2 - p_1)\, av}{550} = \frac{(p_2 - p_1)\, Q}{550} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

By means of equations (5) and (6) we are thus enabled to determine at once the pressure of the compressed gas and the horsepower necessary to operate the impeller, be the gas air or any other of the perfect gases.

As an example let us compute the final pressure and horsepower necessary to operate a rotary air compressor which has 45 stages of compression, a shaft efficiency of 75 per cent, an outer peripheral speed of 400 ft. per sec., taking in air at 14.7 per sq. in., and delivering 1,000 cu. ft. per min.

We have previously found that for adiabatic compression of air, we have

$$n = \frac{c_p}{c_v} = \frac{.2375}{.1685} = 1.41,\ e = .75,\ p_1 = 14.7 \times 144,\ N = 45,$$

$$Q = \frac{10000}{60},\ g = 32.16,\ \text{and}\ v_1 = 13.1.$$

Hence substituting in equation (5), we have

$$p_2 = 14.7 \times 144 \left[1 + \frac{(1.41 - 1)}{1.41} \frac{.75 \times 45 \times 400^2}{32.16 \times 14.7 \times 144 \times 13.1} \right]^{3.44}$$

$$= 14.7 \times 144 \left[1 + 1.7605 \right]^{3.44}$$

$$= 14.7 \times 144 \times 32.9 = 69{,}650 \text{ lb. per sq. ft.}$$

or 481 lb. per sq. in.

Again we find the horsepower necessary by substituting in equation (6)

$$\text{H P} = \frac{(p_2 - p_1)\, Q}{550} = \frac{(69{,}650 - 14.7 \times 144)\, 1000}{550 \times 60} = 205.8. \quad \text{Ans}$$

Thermotwisters.

1. What would be the mean effective pressure of the air in the illustrative example in the above lecture?

2. A rotary compressor operates with carbon dioxide under the same conditions given in the above example, what will be the final pressure and the horsepower required?

CONSERVATION AND USE OF NATURAL GAS.

The Bureau of Mines has just issued Technical Paper No. 10, Liquefied Products from Natural Gas: Their Properties and Uses, by Irving C. Allen and George A. Burrell, in an effort to show how natural gas, which is being allowed to escape almost without restraint in almost all of the petroleum fields of the country, may be conserved. The authors of the technical paper, in outlining their investigations, say:

By fractionating natural gas, either during or after liquefaction, four products can be commercially obtained. Roughly, these four products may be described as follows: (1) The gaseous product, the common natural gas of commerce; (2) the semi-liquid product, known as the new "wild" product, which should be used only as a liquefied gas and should be held in high-pressure steel containers only; (3) the light liquid product, or light gasoline used for blending with heavy naphthas; and (4) the heavy liquid product, or ordinary high-grade gasoline.

The possibility of handling the second product in the way that Pintsch and Blau gases are handled, enabling small towns, hotels and country estates to have the advantage of gas illumination, manifestly opens a new field of comparatively great importance in the natural gas industry and should add materially to the investments made in the so-called "natural gasoline" industry.

The liquefaction of gases by pressure is not a new industry, but only recently has its application to natural gas been recognized as practicable.

Up to the last two years the general practice in the manufacture of liquid natural gas was to make the product by compression of the gas in single-stage compressors operated at a pressure of 150 to 300 pounds per square inch. The one product obtained, so-called "natural gasoline"; was run into a tank and "weathered." The weathering consisted in allowing the lighter portions to volatilize spontaneously and escape into the open air until such time as the boiling away of the liquid had practically ceased. Thus the process involved a loss of 25 to 50 per cent, or even more. This loss was an absolute waste, not only of power and of cost of operating the engines and compressors but of the product itself.

The next step in the industry was to pass the waste gases (of which only the small quantity used for power had been utilized) from the single-stage compressor through a higher-stage compressor, thereby getting a second and more volatile product—a "wilder" liquid—which was run back into the first and mixed with the first or heavier condensate. This mixture was then again weathered to a safe degree, whereby it lost the greater part of the more volatile product that had been condensed in the second stage.

Recently the process had been improved another step, in that the first stage compressor product is run into one tank and handled as ordinary gasoline; the second compressor product is run into a second tank and handled as a lighter gasoline, with which the heavy refinery naphthas can be enriched or enlivened.

The last-mentioned method of using the second stage compressor product should receive wide recognition, and a market for the product should develop that would be no mean factor in the industry. Blending in the proportions of, say, 1 part of the product to 4 or 5 parts of the refinery naphthas makes these heavy naphthas more volatile and of greater value as fuel for automobiles; it also greatly increases their general usefulness. The proportions to be used in blending, however, must be determined more definitely by test.

The natural gas of this country frequently contains light products that do not condense in the second-stage compressor, and for which it is practicable and necessary to install three, four, and even higher stage compressors. These light products—true gases at ordinary temperatures and pressures—can be compressed and liquefied, but the liquid gases so obtained must be handled as gases and not as oils.

The mistake heretofore made in the "natural gas gasoline" industry, as some have recognized, has been the attempt to handle the light gaseous products as oils and not as gases.

PROPOSALS AFFECTING MEMBERSHIP IN THE A. I. E. E.

Realizing the immense importance of the present agitation among the members of the American Institute of Electrical Engineers to create an additional grade of membership, we have communicated direct with the secretary of the A. I. E. E., Mr. F. L. Hutchinson, and have received the following data relative to the transfer of members to the proposed grade of "fellow." Our own views may be found on the editorial page of this issue.

The matter of transfer of present Associates to the grade of Member, and present Members to the grade of Fellow, received long and careful consideration by the Additional Grade of Membership Committee and also by the Board of Directors of the Institute, as a result of which the plan provided in the proposed amendments was decided upon. Under this plan, a present Associate may be transferred to the grade of Member upon making application to the secretary prior to May 1, 1913, without the payment of a transfer fee, by referring to four Fellows or Members, who, upon inquiry, on a form which will be issued from the Secretary's office, shall certify that the applicant meets the requirements for the grade of Member as defined in the Constitution.

Similarly, a present Member may be transferred to the grade of Fellow by making application to the secretary prior to May 1, 1913, without the payment of a transfer fee, provided he refers to at least five Fellows or Members, who, upon inquiry, on a form which will be issued from the secretary's office, shall certify that the applicant meets the requirements for the grade of Fellow as defined in the Constitution. The requirements for the grades of Fellow and Member are given in full in the February proceedings.

At first, it was the intention of the committee to recommend that all present Members be automatically transferred to the grade of Fellow, but, inasmuch as the annual dues for Fellows under the proposed amendments will be $20, and the present dues of Members are $15, it was thought that it would not be just to automatically transfer Members without application, and therefore the provision was made that each Member should apply for transfer, but it should be understood that in making this application, it will not be necessary to submit a record of the applicant's training and experience, but merely to refer to at least five Fellows or Members. A simple form will be prepared which will be sent to the references. This form will contain the requirements as specified in the Constitution for the various grades of membership with a space in which the referee may state, whether, in his opinion, the applicant meets these requirements. Upon receipt of the required five favorable replies, the applicant will be transferred to the grade of Fellow. It is the expectation that there will be very few of the present Members who will not apply, consequently it is the belief of the committee and the board of directors, that practically all the present Members will become Fellows. Those, however, who do not desire to pay the additional five dollars annually for dues, or who, or any other reason wish to remain Members instead of becoming Fellows, may do so by simply refraining from making the required application.

There will, of course, be some of the present Members who will not be eligible for immediate transfer to the grade of Fellow, for the reason that one of the requirements for admission to that grade is that "he shall have been in the active practice of his profession for at least ten years," whereas, the corresponding requirement for admission to the grade of Member stipulates only five years of active practice. This increase in the number of years experience required, was carefully considered, and while it was recognized by the committee and by the board of directors that this would render ineligible for immediate transfer to the grade of Fellow a few of the younger Members, it was thought that this increase in the standard of the highest grade was desirable, and would work no great hardship upon the comparatively few Members who would be affected by it for the reason that it would simply require them to delay their transfer for one or two years.

The proposed amendments were recommended by the unanimous vote of the Additional Grade of Membership Committee and were approved by the unanimous vote of the Board of Directors.

A. I. E. E. CODE OF ETHICS.

The following code of principles of professional conduct of the American Institute of Electrical Engineers, was adopted by the Board of Directors, March 8, 1912. While the principles express, generally, the engineer's relations to client, employer, the public, and the engineering fraternity, it is not presumed that they define all of the engineer's duties and obligations.

A. General Principles.

1. In all of his relations the engineer should be guided by the highest principles of honor.

2. It is the duty of the engineer to satisfy himself to the best of his ability that the enterprises with which he becomes identified are of legitimate character. If after becoming associated with an enterprise he finds it to be of questionable character, he should sever his connection with it as soon as practicable.

B. The Engineer's Relations to Client or Employer.

3. The engineer should consider the protection of a client's or employer's interests his first professional obligation, and therefore should avoid every act contrary to this duty. If any other considerations, such as professional obligations or restrictions, interfere with his meeting the legitimate expectation of a client or employer, the engineer should inform him of the situation.

4. An engineer can not honorably accept compensation, financial or otherwise, from more than one interested party, without the consent of all parties. The engineer, whether consulting, designing installing or operating, must not accept commissions, directly or indirectly, from parties dealing with his client or employer.

5. An engineer called upon to decide on the use of inventions, apparatus, or anything in which he has a financial interest, should make his status in the matter clearly understood before engagement.

6. An engineer in independent practice may be employed by more than one party, when the interests of the several parties do not conflict; and it should be understood that he is not expected to devote his entire time to the work of one, but is free to carry out other engagements. A consulting engineer permanently retained by a party, should notify others of this affiliation before entering into relations with them, if, in his opinion, the interests might conflict.

7. An engineer should consider it his duty to make every effort to remedy dangerous defects in apparatus or structures or dangerous conditions of operation, and should bring these to the attention of his client or employer.

C. Ownership of Engineering Records and Data

8. It is desirable that an engineer undertaking for others work in connection with which he may make improvements, inventions, plans, designs, or other records, should enter into an agreement regarding their ownership.

9. If an engineer uses information which is not common knowledge or public property, but which he obtains from a client or employer; the results in the form of plans, designs, or other records, should not be regarded as his property, but the property of his client or employer.

10. If an engineer uses only his own knowledge, or information which by prior publication, or otherwise, is public property and obtains no engineering data from a client or employer, except performance specifications or routine information; then in the absence of an agreement to the contrary the results in the form of inventions, plans, designs, or other records, should be regarded as the property of the engineer, and the client or employer should be entitled to their use only in the case for which the engineer was retained.

11 All work and results accomplished by the engineer in the form of inventions, plans, designs, or other records, that are outside of the field of engineering for which a client or employer has retained him, should be regarded as the engineer's property unless there is an agreement to the contrary.

12. When an engineer or manufacturer builds apparatus from designs supplied to him by a customer, the designs remain the property of the customer and should not be duplicated by the engineer or manufacturer for others without express permission. When the engineer or manufacturer and a customer jointly work out designs and plans or develop inventions a clear understanding should be reached before the beginning of the work regarding the respective rights of ownership in any inventions, designs, or matters of similar character, that may result.

13. Any engineering data or information which an engineer obtains from his client or employer, or which he creates as a result of such information, must be considered confidential by the engineer; and while he is justified in using such data or information in his own practice as forming part of his professional experience, its publication without express permission is improper.

14. Designs, data, records and notes made by an employe and referring exclusively to his employer's work, should be regarded as his employer's property.

15. A customer, in buying apparatus, does not acquire any right in its design but only the use of the apparatus purchased. A client does not acquire any right to the plans made by a consulting engineer except for the specific case for which they were made.

D. The Engineer's Relations to the Public

16. The engineer should endeavor to assist the public to a fair and correct general understanding of engineering matters, to extend the general knowledge of engineering, and to discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in the press or elsewhere, especially if these statements may lead to, or are made for the purpose of, inducing the public to participate in unworthy enterprises.

17. Technical discussion and criticisms of engineering subjects should not be conducted in the public press, but before engineering societies, or in the technical press.

18. It is desirable that first publication concerning inventions or other engineering advances should not be made through the public press, but before engineering societies or through technical publications.

19. It is unprofessional to give an opinion on a subject without being fully informed as to all the facts relating thereto and as to the purposes for which the information is asked. The opinion should contain a full statement of the conditions under which it applies

E. The Engineer's Relations to the Engineering Fraternity.

20. The engineer should take an interest in and assist his fellow engineers by exchange of general information and experience, by instruction and similar aid, through the engineering societies or by other means. He should endeavor to protect all reputable engineers from misrepresentation.

21. The engineer should take care that credit for engineering work is attributed to those who, so far as his knowledge of the matter goes, are the real authors of such work.

22. An engineer in responsible charge of work should not permit non-technical persons to overrule his engineering judgments on purely engineering grounds.

F. Amendments.

Additions to, or modifications in, this Code may be made by the board of directors under the procedure applying to a by-law.

CASH BOXES ELIMINATED.

Experiments in collecting fares from patrons of the "pay-as-you-enter" cars without the aid of the cash box have proven so successful that the Portland Railway, Light & Power Company has decided to remove the boxes from all the cars that have been so equipped. Hereafter passengers on the pre-payment cars will give their fares to the conductors direct. When it is necessary correct change will be given back and the passenger will pass into the car without stopping to drop a nickel into the box.

DATA ON HYDROELECTRIC DEVELOPMENT.

An interesting compilation of data on hydroelectric development in the United States has just been completed by Herbert Knox Smith, commissioner of corporations. This data has been presented to President Taft with recommendations. The increasing concentration or combination of hydroelectric enterprises has led Commissioner Smith to recommend that the government should preserve title to the remaining power sites and develop them to prevent a possible monopolization of public utility companies. Items from this report appear in the following lines.

The water power of the country, developed and practically capable of development at this time, probably does not exceed 25,000,000 horsepower. The total developed water power today is about 6,000,000 horsepower. The total stationary power used in the United States—steam, water and gas—is probably more than 30,000,000 horsepower.

The bureau of corporations, in its investigations, found concentration of water powers in three distinct phases. First, there is a centralization of control in each important locality; secondly, large interests influence a number of these local concerns, and finally there is found a growing relationship among the big interests.

In California six great power corporations, of which the most important is the Pacific Gas & Electric Company, with 118,343 horsepower, together control 375,000 horsepower, over 80 per cent of all the developed water power in the State.

In Washington two companies control 210,000 horsepower, or about 70 per cent of all developed water power.

In South Carolina, the Southern Power Company owns about 101,000 horsepower, or 75 per cent of the total commercially developed, with 73,000 horsepower undeveloped.

In the southern peninsula of Michigan the Commonwealth Power, Railway & Light Company controls 52,000 horsepower, or 73 per cent of the commercially developed, together with probably 71,000 horsepower more undeveloped.

Practically similar conditions exist in Montana, Colorado, Georgia and at Niagara Falls.

More important than this local centralization are the operations of ten large groups of interests which possess control or influence more than 1,821,000 developed horsepower, about 60 per cent of the commercial waterpower in the United States together with 1,449,000 horsepower undeveloped.

The General Electric interests control or influence 939,000 horsepower of developed water power in eighteen different States and 640,000 horsepower of undeveloped resources, a grand total of over a million and a half horsepower. Next are the Stone & Webster interests, which either own or strongly influence 278,000 horsepower, chiefly in connection with public service concerns. They exercise control, largely through management rather than ownership, over fifty-five or sixty companies. Eight have waterpower, the largest being the Mississippi River and Puget Sound region.

The other groups are the Hydraulic Power Company, of Niagara Falls, 144,000 horsepower; the Pacific Gas & Electric Company, with over 118,000 horsepower developed and the dominating factor in a large portion of California the group known as the Clark-Foote-Hodenpyl-Walbridge interests, 104,000 horsepower, largely dominating the water power situation in Michigan and also active in Maine and Oregon; the Southern Power Company, 101,000 horsepower, which owns the bulk of the commercially developed power in South Carolina; the S. Morgan Smith Interests, (Georgia) 76,000 horsepower; the Brady interests, (Tennessee) 70,000 horsepower; The United Missouri River Power Company, 65,000 horsepower, which with the Butte Electric Power Company (General Electric Group) practically dominates the power situation in Montana; and the Telluride Power Company (Colorado, Idaho and Utah) 65,000 horsepower. The last named nine interests also include under their influence 887,000 horsepower undeveloped.

Carrying the community of interests to a wider range, these groups show more or less relationship with each other. The two greatest, the General Electric and the Stone & Webster groups, have directors in a number of the same corporations, and the S. Morgan Smith, Westinghouse and Brady interests are similarly connected.

The companies in the General Electric group control street railways in sixteen towns, electric lighting plants in seventy-eight and gas plants in nineteen. Altogether, water power or allied companies own or control and operate street railways in 111 towns, electric lighting plants in 669 towns and gas plants in 113 towns.

The reasons for this are obvious. Control of the chief consumers of power both insures a market for power and excludes others. This connection between great power groups and the agencies that directly serve the public is of serious public significance.

A more general relationship of a sort not peculiar to water power, but nevertheless of broad public significance, is best illustrated in the General Electric Company. Men who are officers or directors in that company or of its three wholly controlled subsidiaries are also officers and directors in many other corporations. These other companies, with their subsidiaries, make a far-reaching group thus interconnected by active personal and financial relationship.

This one group of interrelationships controls or influences twenty-four corporations that operate hydroelectric plants; over fifty public service corporations, not counting as many minor subsidiaries; more than a dozen railroads; numerous industrial corporations; and, finally, over fifty banks and financial houses, many of them in the first rank of importance. About twenty General Electric men in all constitute most of this chain of connection, three of those being members of the firm of J. P. Morgan & Company, which is generally regarded as the dominant interest in the General Electric Company. These connections in no sense always mean control by the General Electric Company, or even identity of policy. They do, however, mean a striking degree of community interest.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Telephone Combination

That the Pacific Telephone & Telegraph Company should announce the absorption of the Home Telephone Company of San Francisco just one week before the California State Railroad Commission assumes its new duties of public service corporation regulation and control is apparently no mere coincidence but the result of the craftily calculated plans whereby the Bell company is now trying to stifle all competition on the Pacific Coast, irrespective of the desires of the people.

In the first days of electrical apprenticeship, the most lasting and impressive lesson taught is that of making a secure and efficient joint between two wires. The connecting ends should be prepared and carefully sand-papered in order that the binding material may perform its function with greater efficiency. Non-observance of instructions invariably resulted in a joint that did not prove lasting but usually brought disaster and with it a considerable suffering in reputation.

The people of the great State of California gave vent to their will and feelings last fall—and justly too —in no uncertain manner in regard to regulation of public service corporations. Most of these corporations have not only signified their willingness to meet the people half way, but in many instances have won over the admiration and respect of the people by evidences of fair-mindedness. In fact the great body of conservative citizens of the State have largely changed their views and are loud in their praise of this attitude. The people are consequently coming into the belief that perhaps the heads of these corporations are at times like themselves almost human in their makeup.

The overt act of last Saturday on the part of the Pacific Telephone & Telegraph Company in boldly making a union without the expressed sentiment of the people when they knew that sentiment would be forcefully expressed in no uncertain terms one week later by a review of the State Railroad Commission not only discredits the telephone company but will have a tendency to put unfavorable and unjust criticism upon other corporations. How the rabid element in public service control will now gloat over the scalp of this combination if it can be legally secured. Those who are inclined to be fair-minded and conservative feel, too, that the act should be condemned. As in the improper forming of the soldered union without first preparing the joints for the binding material, we are taught to break the joint apart and do the work properly, so this combination should be disrupted, or at least thoroughly investigated and the will of the people in the way of reasonable control should be forcefully exerted.

Many who welcome the elimination of the duplicate telephone system, with its attendant inconvenience, find no fault with the consolidation, but only in the audacious manner of its accomplishment. But

that the ten million dollars, which is reported to have been paid for what will soon be little more than a pile of junk, should be included in the capital stock upon which they will be asked to pay dividends for all time to come is at once unjust and unreasonable.

The Corporation and the Commission

Individuals alone never succeed. Individuals are successful only as they make themselves so by helping the community. And so it will be in the life of the successful public service corporation of the immediate future. Corporations, like individuals, can only retain an education by giving it away to others, and the more people they give it to, the more education they will have left.

Candidness and open-minded fairness seem now to be characteristics of our western public service corporation regulation sentiment. Indeed, for getting at the true facts of costs and the fair fixing of rates, many of the western corporations are even going the commissioners one better in predetermining a just valuation—a valuation fixed upon such a firm and equitable foundation, no reasonable hearing will ever result in anything but affirmative approval.

The well-defined attitude of the largest hydroelectric enterprise on the coast—the Pacific Gas & Electric Company—may be cited as an instance of this newer and higher ethical development in corporation life. A corporation setting out with the avowed purpose of studying how to increase efficiency to the highest degree and how to fix scientifically just and absolute rates at all points of its great system, and, then, with this data in hand, as easily read as an open book, proposing to stand ready for any investigation, not only puts itself in the most favorable public light, but materially aids in increasing the efficiency of our nation. A careful compilation of cost data concerning hitherto unknown hydroelectric and steam generating deliveries means advanced methods and more efficient operation for human industries. Electrical energy possesses two unusual negative characteristics—it cannot be frozen and it can never be adulterated. The modern milkman, when delivering under a lax board of supervisors may continue to whiten up his liquid supply, and Mrs. Wiggs, when company arrives, may continue to add a little more water to the soup, but although the modern long distance transmission of electrical energy may resemble in one particular the proverbial lump of boarding-house butter, in which little bit is said to go a long way, yet when electric energy is applied this unadulterated gift of nature, the captive power of the water fall—is delivered in its prestine purity.

When the wheels of industry are thus turning under the keen supervision of men versed in economic operation and in addition only a reasonable and fair return is asked for service delivery, our hydroelectric enterprises, now rapidly becoming the most substantial investments, may well feel secure for the future.

Proposals Affecting A.I.E.E. Membership

On January 1, 1912, the complete summary of membership in the American Institute of Electrical Engineers showed that there are at present 6 honorary members, 705 members and 6450 associate members, thus making a total of 7161.

A glance through the present large membership of the associate grade indicates that there is a great variation in engineering attainments. Here may be found chief engineers and designing engineers by the hundreds necessarily occupying the same status in the institute as the young engineer just out of college, embarking on an engineering career. This condition of affairs is a necessary adjunct to the present method of membership in the institute, for, since the reputation of an engineering society, is largely known from the composition of its highest grade, only those of preeminent attainments have been allowed to enter the present grade of member. This, then, accounts for the fact that at present the grade of membership constitutes only one-tenth of the institute enrollment.

The creation of the new grade of Fellow is, indeed, a happy thought. In recent years our profession has grown in importance and dignity. With this growth in dignity should come an advanced code of qualifications for highest attainments in our national body. At the same time the field of recognition for that great intermediate class should be widened, so that more of our deserving engineers can be recognized.

Any readjustment requires much agitation and often much injustice. The February proceedings of the institute give the details of the proposed change by which the present roll of members will pass into the grade of Fellow by certification of five members that the new constitutional provisions are met in the individual case under consideration. This certainly will accomplish the readjustment in as fair and equitable a manner as could be hoped for. For the good of the institute, it behooves all those having its welfare at heart to get active at once. To become effective, at least 30 per cent of the membership must vote upon the constitutional amendments, and 75 per cent of this vote must be affirmative. The coast members of the institute, ever yearning in synchronism with the highest ideals, ever ready to propose and support efficient means to accomplish these ideals, should perform their duty by favorable agitation and an early affirmative vote in behalf of the amendments.

Shades of old father Noah! Reports from Baguio near Manila, P. I., show a recent precipitation of 3.60 inches of rain in one hour, 40 inches in 24 hours, and 80 inches in three days. Water must have fallen there as thick as shells on Dewey Day some years back. Anyhow there must certainly be available a few teaspoonfuls of storage water for the hydroelectric enterprises in the Philippines.

PERSONALS.

H. B. Squires of Otis & Squires is visiting Portland and Seattle.

Rudolph W. Van Norden, consulting engineer, is at Fresno.

Melville Dozier Jr., of Sacramento, was at San Francisco this week.

R. E. Starkweather, electrical engineer, is at Los Angeles on business.

L. R. Wiley, an engineer of Groveland, was a recent visitor at San Francisco.

H. C. Keyes, head of the Sacramento Gas Company, was a recent San Francisco visitor.

Nisbet Latta, vice-president and chief engineer of the Wisconsin Gas Engine Company, is at San Francisco.

J. B. Lukes, who represents the Stone & Webster interests, with headquarters at Reno, Nev., is at San Francisco.

C. O. Poole, of the firm of Manifold, Poole, consulting electrical engineers recently spent a few days at San Francisco.

Wynn Meredith, of the firm of Sanderson & Porter, has been at Los Angeles during the past week on important engineering business.

John S. Baker, district manager for the Crocker-Wheeler Company, has returned to his San Francisco office from a business trip through California.

John Coffee Hays, who manages the Mount Whitney Power Company and allied electrical interests, was at San Francisco from Visalia last week.

Bertram M. Downs, who recently resigned as vice-president and general manager of the Hemingray Glass Company, is making a tour of the Pacific Coast.

Thomas Mirk, of the firm of Hunt, Mirk & Co., has returned to San Francisco from San Diego, where one contract is nearly finished and another will soon be.

A. B. Cass, who is president of the Home Telephone Company of Los Angeles, and also manager of the Bay Cities Home Telephone Company, is at San Francisco.

A. M. Hunt, who recently returned to the United States after spending several months in touring Europe, is expected to arrive at San Francisco in about two weeks.

J. A. Clay, general manager of the San Juan Water & Power Company and the Triangle Gas & Electric Company of Durango, Colo., is a recent San Francisco visitor.

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, recently spent several days at San Francisco conferring with his consulting engineers.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, is expected to reach San Francisco on his return trip from the Hawaiian Islands about March 26th.

O. W. Lillard, Pacific Coast manager for the Gould Storage Battery Company, with works at Depew, N. Y., has returned to his office at San Francisco after an extensive tour of the Pacific Northwest.

At a recent meeting of the Pacific Gas & Electric Company, J. H. Hunt, the purchasing agent, and Joseph C. Love, the assistant treasurer, were elected as directors in place of Louis Monteagle and J. S. Tobin, resigned.

G. I. Kinney, district manager of the Fort Wayne Electric Works at San Francisco, is making a trip throughout the eastern states in the course of which he will attend the annual convention of the Fort Wayne company at Fort Wayne, Indiana.

R. S. Buck, of the firm of Sanderson & Porter, left San Francisco recently for Salt Lake City, Utah, Boise and other Idaho cities, to investigate and report on the engineering features of certain irrigation projects.

W. A. Robb, local manager of the Western Union Telegraph Company at Portland, visited San Francisco during the past week as one of the large party who came by special train to select the site for the Oregon State building at the Panama-Pacific Exposition grounds.

J. T. Shaw, assistant division commercial engineer of the Pacific States Telephone & Telegraph Company at San Francisco, has resigned to accept a position with the California State Railroad Commission. Mr. Shaw's new duties will have particular reference to the telephone public utility companies.

C. H. Moore, district manager of the Pacific Telephone & Telegraph Company, with headquarters at Portland, was one of the 250 excursionists on the special train of twelve cars which recently arrived at San Francisco from Oregon. By the courtesy of his company a telephone switchboard was installed in the observation car and a station in each of the other cars. Connection with trunk lines was made from the train during the stops at the cities included in the itinerary. Among the other excursionists on the "Oregon First" train were R. J. Sheets of the Linkville Electric Company of Klamath Falls and George M. Hyland, president of the Mount Hood Railway & Development Company of Portland, and Mrs. Hyland.

TRADE NOTES.

An address illustrated with stereopticon views of Pittsburg and the Westinghouse shops was given at the last semi-monthly sales meeting of the Pacific Gas & Electric Company by Richard F. Behan, assistant to the district manager of the Westinghouse Electric & Manufacturing Company at San Francisco.

The Midway Gas Company has secured a franchise from the Kern County Supervisors for a 3-pipe line extending from the Midway oil fields to the Los Angeles County line. J. G. White & Co., the supervising engineers, have received notice of the shipment of a large quantity of the pipe through which natural gas is to be supplied for Los Angeles consumers.

The General Electric Company has sold a 15,000 kw. steam turbine and some large transformers to the Southern California Edison Company for installation at the Long Beach power plant near Ostend station. The apparatus is described as follows: One A. T. B. S. 15,000 kw., maximum, (18750 k.v.a., at .8 power factor) 750 r.p.m., maximum rated vertical Curtis turbine generating set with condenser base. Also three F. O. 50 cycle, 6250 kw., 37600-65,000 Y., 11,000-v., forced oil type transformers.

A. I. E. E. COMMITTEE ON ORGANIZATION OF INTERNATIONAL ENGINEERING CONGRESS.

Gano Dunn, president of the American Institute of Electrical Engineers, has announced that the officers of the Committee on Organization of the International Electrical Congress of San Francisco 1915, will be: Dr. Charles P. Steinmetz, president; Dr. A. E. Kennelly, vice-president, in charge of program; C. O. Mailloux, vice-president, in charge of international relations; W. D. Weaver, vice-president, in charge of organization; Henry A. Lardner, vice-president, in charge of Pacific Coast relations; Dr. E. B. Rosa, of the United States Bureau of Standards, secretary; Preston S. Millar, of the Electrical Testing Laboratories, treasurer and business manager.

The body of the committee will be announced later, as will also be the advisory and honorary members, which are

to be chosen by the committee itself with the co-operation of the International Electrotechnical Commission and of the engineering, scientific and technical bodies of the United States, Canada and Mexico.

The memorial of the convention of delegates of American engineering societies held in San Francisco on January 15th to formulate plans for holding an International Engineering Congress at San Francisco, having been sent to all the members of the Board, which at its meeting in January voted to support such a general engineering congress, was referred to the Committee on International Electrical Congress for recommendations.

The directors' nominees for officers of the American Institute of Electrical Engineers for the ensuing year are as follows: For president, Mr. Ralph D. Mershon, of New York; for vice-presidents, Mr. William S. Murray, of New Haven, Mr. Arthur W. Berresford of Milwaukee, Mr. S. D. Sprong of Brooklyn; for managers, Prof. Comfort A. Adams of Cambridge, Mr. William B. Jackson of Chicago, Mr. J. Franklin Stevens of Philadelphia, Mr. William McClellan of Albany; for treasurer, Mr. George A. Hamilton of Elizabeth; for secretary, Mr. F. L. Hutchinson of New York.

A. I. E. E. MEETING NOTICES.

The Portland Section met in the Assembly Hall of the Electric Building at 8 p. m., Tuesday, March 19, 1912. E. D. Searing presented a paper, entitled, "The Steel Tower Transmission Line of the Portland Railway, Light & Power Company," giving some interesting details in regard to its design and construction.

The San Francisco Section of the American Institute of Electrical Engineers will meet at the Home Telephone Company's Building, 333 Grant avenue, at 8 p. m. A paper will be presented on the recent installation and performance of two large turbo-generators at Stations A and C of the Pacific Gas Gas & Electric Company, including the results of boiler tests at Station C by Frank H. Varney, Robert Sibley and R. F. Chevalier.

The March meeting of the Seattle Section, A. I. E. E. was held Saturday evening, March 16th, 1912, in the Assembly room, eight floor Central Building. Hydroelectric construction was the principal subject of this meeting. N. A. Carle of the Puget Sound Bridge & Dredging Company presented a paper on the Construction of Dams, taking up the failure of dams at Austin, Pa., and other places, and showing a design of dam which will prevent these failures. The paper was illustrated with a moving picture film and a number of slides. O. N. Wiswell, who has been in charge of the Snoqualmie Falls plant for eight years, presented a short paper on the Maintenance of Hydroelectric Plants, and an interesting discussion followed.

ELECTRICAL CONTRACTORS' NOTES.

F. Newberry, president of the Newberry-Benheim Electric Company, with offices in Chicago, New Orleans, Houston, Los Angeles and San Francisco, is spending a week in San Francisco looking after his local interests. On Wednesday, March 20th, Mr. Newberry met with the local contractors and gave them an interesting talk on the cost of running a contracting business.

The Turner Company has been awarded the wiring for a six-story Class C hotel, for Samuel Knight, on O'Farrell street, San Francisco.

The National Electric Company was awarded a $2000 job of wiring for A. H. Wilhelm at 323-325 Sutter street, San Francisco.

The following notes for contractors are from the pen of J. N. Pierce of Chicago, and well worth following:

1. Just keeping busy will not feed your families. There must be a profit in your work.
2. No man is a good enough guesser to keep his cost system by guess.
3. Exercise your philanthropy by contributing to the Associated Charities rather than furnishing work below cost.
4. Take care of the overhead charges or you will be underneath.
5. Taking jobs at exact cost is all right, providing the only thing a man needs is exercise.
6. If the overhead charges do not include your own salary, you must be working for the pure joy of labor.
7. Be sure you are right and then don't let the general contractor bluff you.

	First.
8. Cost of job	$5000
Overhead, 20 per cent	1000
	$6000
Profit, 10 per cent	$ 600
Your bid	$6600
	Second.
32 per cent of $5000	$1600
Cost of job	5000
Overhead and profit	1600
Your bid	$6600

Note. See table for figuring net profits. Just a case of simple arithmetic.

9. Those who work for less than cost this year, will be working for something less next year.
10. The man without a cost system is trusting altogether too much to Providence.
11. If you don't know what your overhead is costing, hire a man who does know, to tell you.
12. It is by having a real rather than a paper profit on a job, that a contractor is able to make connections with money that will pass inspection at the bank.
13. Cut-throat competition is war, and war is hell.

Note. Does this mean you?

The California State Electrical Contractors will meet in San Jose during the second week in August. We have the jobbers, manufacturers, Sons of Jove, Development League, and other electrical bodies. Why not turn the week at the Garden City into a big electrical get-together proposition. The contractors will show you a good time, as they have always done in the past. "How about that, Sandy?"

The Santa Barbara Grand Jury makes the following report.

"In the matter presented to our body by Mr. G. E. Potter, after examining Messrs. C. D. Kenyon, J. S. Reynolds, Claude Loveday, Fred Neilson and G. E. Potter, we find no grounds exist for indictment under the law against the Electrical Contractors' Association No. 7 of the California State Association of Electrical Contractors."

The following table is being distributed through California to all electrical contractors of the California State Association of Electrical Contractors:

TABLE FOR FIGURING NET PROFITS.

If your cost of doing business figured on gross sales is represented by one of these figures.

Your percentage of net profit is represented by the figure at the junction of the two columns.

EXPLANATION.—If your cost of doing business is 15% of your gross sales, and you add 25% to your cost of labor and materials your net profit is 5% on sales. If your cost of doing business is 18% and you add 60% to your cost of labor and materials, your net profit is 19 1/2% on sales.

And you add to your cost of labor and materials one of these percentages.

	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
25%	10	9	8	7	6	5	4	3	2	1	00	1 Loss	2 Loss	3 Loss	4 Loss	5 Loss
33 1/3%	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	00
40%	18 3/5	17 3/5	16 3/5	15 3/5	14 3/5	13 3/5	12 3/5	11 3/5	10 3/5	9 3/5	8 3/5	7 3/5	6 3/5	5 3/5	4 3/5	[illegible]
50%	23 1/3	22 1/3	21 1/3	20 1/3	19 1/3	18 1/3	17 1/3	16 1/3	15 1/3	14 1/3	13 1/3	12 1/3	11 1/3	10 1/3	9 1/3	8 1/3
60%	27 1/2	26 1/2	25 1/2	24 1/2	23 1/2	22 1/2	21 1/2	20 1/2	19 1/2	18 1/2	17 1/2	16 1/2	15 1/2	14 1/2	13 1/2	12 1/2
75%	32 6/7	31 6/7	30 6/7	29 6/7	28 6/7	27 6/7	26 6/7	25 6/7	24 6/7	23 6/7	22 6/7	21 6/7	20 6/7	19 6/7	18 6/7	17 6/7
100%	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25

INDUSTRIAL

500,000-VOLT TESTING TRANSFORMERS.

Notable among new equipments is a 500,000 volt testing transformer recently built by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., for insulation tests on high voltage power transformers and other high tension apparatus. Its design illustrates an ingenious handling of the problem of insulation, whereby this extremely high voltage is taken care of in a very satisfactory manner without increasing the amount of insulating material used, or the bulk of the apparatus, to an excessive degree.

It will be seen that the transformer has only one high tension terminal, the other end of the winding being grounded. As all insulation tests, almost without exception, can be made with one side grounded, this feature is not objectionable but on the contrary has many advantages.

It will be noted that, with one end of the high tension winding grounded, it is necessary to insulate the ungrounded end and also the high tension terminal for the full transformer voltage. On the other hand, if the middle point of the winding were grounded and both ends brought out through insulated terminals, it would be necessary to insulate the ends of the winding and the terminals for only one-half the transformer voltage; for example, if the voltage between terminals is 750,000, it would be necessary to insulate the winding and terminals to ground for only one-half this amount or 375,000 volts. From this it will be seen that the insulation problem for the given terminal voltage is a much more difficult one when one end of the winding is grounded than when the middle point is grounded. A considerable proportion of insulation tests made are from the windings of the apparatus under test to ground, and to make such tests with a transformer having the middle point grounded is most inconvenient because it necessitates the placing of the apparatus on a support insulated from ground for one-half the test voltage.

The problem of insulation is solved in an ingenious way. The insulation of the low-tension winding and between high-tension and low-tension, is a simple matter, accomplished by means of insulating cylinders. The high-tension winding is insulated from the core, not by interposing large masses of insulation, but by subdividing the high tension winding and so connecting the coils that the coil with maximum potential to ground is located at the greatest distance from the yoke. The ungrounded end of the winding is at the middle of the column of coils. The coils placed nearer to the yokes are nearer the grounded end of the winding and their potential to the grounded end of the winding and their potential to ground correspondingly less. The coils at the grounded end of the winding practically touch the yokes. The distance of the coil from the yoke increases with its voltage above ground, and the potential gradient from the ungrounded terminal is therefore fixed and uniform. The windings of this transformer have developed a voltage of 600,000 without any sign of distress.

The high-tension terminal is of the well-known condenser type, made of alternate layers of insulating material and tin foil so proportioned in length and thickness that the foil so proportioned in length and thickness that the potential gradient along the surface from line terminal to ground is approximately uniform. The large "hat" on top of the terminal is provided to prevent corona effect. The hat is made of wood, coated with tin foil. Its effect is to make the static field from line terminal to ground uniform, and to prevent concentration of static field. Without the hat, corona was present at about 350,000 volts. With the hat there is no corona up to 570,000 volts.

D. E. G. ELECTROLYTIC GENERATORS.

The standard type of generators for electrolytic work as offered by the General Electric Company, are 4-pole machines built in sizes 1.5 kw., 3 kw., 5 kw., 10 kw. and 15 kw. They run at the standard speed so that they may be direct driven by induction motors where alternating current of 60 cycles is available if so desired.

Thorough ventilation of the armature ensures cool running. Fan blades, fastened to the armature heads, in connection with air ducts, leading from the center of the core to the circumference, provide adequate ventilation of all parts. The bar windings which are insulated carefully, and connected at the end by copper ribbons, are inserted in insulated slots so that in case of accident to one or more bars, they can be easily removed without disturbing the remainder of the winding. All connections between the armature winding and the commutator are soldered to ensure that there will be no loose connections and consequent sparking at the brushes.

The field coils are wound on forms which permits their easy and quick removal from the poles in case of accident.

The D. E. G. 1 and 2 generators are arranged for one voltage only and consequently have but one commutator. They are self-excited generators and will give potentials of from 2 to 6 volts at 250 and 500 amperes, the voltage regulation being accomplished by varying the field.

The D. E. G. 3, 4 and 5 machines are of the double commutator design, the armature having two distinct windings, one being connected to each commutator. The terminals may be connected so that the two windings will be in series or in multiple, giving a potential equal to the sum of their voltages and the current equal to that generated by one, or a potential equal to that of one winding and a current equal to the sum of the currents from the two windings. The generator may also take the place of two generators, each winding serving as a separate machine.

NEW CATALOGUES.

The Westinghouse Electric & Manufacturing Company has issued folders 4100m and 4101 covering its 1912 line of fan motors. One of these folders is devoted to alternating current fans and the other to direct current fans. Attractive art covers add greatly to their appearance. The new line of steel frame fans is well illustrated and described therein.

The General Electric Company has just issued Bulletins 4926, 4927 and 4930. No. 4296 is devoted to The Application of Electricity to Marine Service, being printed in colors and describing the various pieces of apparatus and supplies manufactured by this company for marine use, and contains data of general interest to motor boat owners. No. 4927 describes the manufacture of Feeder Voltage Regulators. No. 4930 is devoted to the application of electric drive to ice and refrigerating plants, and illustrates the advantages offered by this method of drive as compared with steam power.

A NATIONAL COMMERCIAL ORGANIZATION.

In accordance with the terms of a statement from the President of the United States, the Secretary of Commerce and Labor has issued invitations to over one thousand of the leading commercial organizations of the country inviting them to send representatives to a general conference to be held at Washington, April 15. The idea is to establish a national organization broadly representative of the commercial interests of the whole country.

NEWS NOTES

INCORPORATIONS.

FRESNO, CAL.—Lewis Electric Company, $10,000, by H. W. and I. E. Lewis and S. E. Check.

MERCED, CAL.—Merquin Telephone & Electric Light Company, $25,000, shares $1 each, subscribed $10,150, by A. L. Bruce, David Larson, W. H. Joy, J. W. Bower et al.

SAN FRANCISCO, CAL.—Natomas Water Company, $5,000,000, shares $100 each, subscribed $500, by C. S. Goodrich, J. T. Piggott, G. O'Connor, R. K. Barrows and H. McCurdy.

LEWISTOWN, MONT.—The Lewistown Power Company has been incorporated here, capital $200,000. The company will erect a power plant on Spring creek and furnish the city and individuals light and power.

SAN BERNARDINO, CAL.—Articles of incorporation of the Interstate Telegraph Company, with principal place of business at Carson City, Nev., have been filed here. The company will complete telegraph lines in Nevada and California, and is capitalized at $100,000.

HOLTVILLE, CAL.—The Valley Telephone Company has been organized to take over the stock of the Eastern Telephone Company. A. E. Wright, P. C. Curtis and N. Shaw are directors. The capital stock is $25,000. A 150-mile line reaching to Calexico, Brawley, Imperial and El Centro will be constructed at once.

CANBY, ORE.—M. J. Lee, A. O. Echols and O. M. Lee have filed articles of incorporation, with capital of $100,000, under the name of Canby-Molalla Railroad Company. The company will build an electric line from here through the southeastern section of Clackamas county. It is understood eastern and Walla Walla capital are backing the enterprise.

SAN BERNARDINO, CAL.—Articles of incorporation of the Ontario & Upland Telephhone Company have been filed. The company intends to put in systems and connecting lines in Ontario, Upland and other cities in California. Capital stock $100,000, all of which has been subscribed. Directors, R. B. Campbell, W. A. Freemire, R. Grant White. Principal place of business, Ontario.

EL CAJON, CAL.—Articles of incorporation have been filed for the El Capitan Mutual Water Company, with a capital stock of $90,000. La Mesa is the place of business, with W. R. Andrews, T. J. Bryan, Lemon Grove, and C. H. Haven, Lakeview, as directors. The company will secure water from the water shed and bed of the San Diego River and distribute it to the users at cost.

RIVERSIDE, CAL.—Articles of incorporation have been filed of the Southern California Utilities Company which proposes to furnish power for San Diego, Riverside and Los Angeles Railway Company. Capital stock $10,000,000 with $50,000 subscribed. Riverside is the principal place of business. The incorporators are Charles E. Waire, M. M. Milioe and Lamont Simms of this city, E. Pelonbet of Los Angeles.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the Union Water Company, with capital of $500,000. The company proposes to engage in business of boring artesian wells, and also proposes to build, construct, acquire, own, sell and convey, manage and operate reservoirs, dams, etc., for supplying consumers with water. The directors are Charles W. Taylor, Jerry Sullivan and O. Henry Cavage.

OAKLAND, CAL.—The Pacific Coast Carbon Company which proposes to manufacture all kinds of carbon products, such as are used in motors, dynamos, arc lights, batteries, etc., is to build a factory here. The company is composed of local capitalists, incorporated under the California laws in the amount of $300,000. R. C. Shaw is its president; A. G. Taft, vice-president; W. B. Straub and W. P. Swart, directors, and R. G. Erskine its secretary.

SAN FRANCISCO, CAL.—Articles of incorporation of the San Ramon Valley Railroad were filed with the county clerk recently. The road is to be seven miles long, and will connect Danville and Walnut Creek, in Contra Costa County. The principal place of business will be San Francisco. The capital stock is $250,000, divided into 2500 shares, of which $7400 has been subscribed. The five directors and their subscriptions are as follows: Jessie H. Steinhart, $7000; A. W. Jonas, $100; G. Miller, $100; S. S. Palmer, $100, and Geo. W. Merrill, $100.

SACRAMENTO, CAL.—Articles of incorporation have been filed by the Sacramento interurban railway, which proposes to construct an electric line connecting Sacramento, Fair Oaks, Orangeville and Roseville. The capital stock is $500,000, with $50,000 subscribed. D. W. Johnston of the North Sacramento company is the heaviest stock holder. Other directors are M. N. Williamson, Marshal Diggs, Ray C. Waring, A. D. Kildahl, Charles E. Hollister and James F. Elliott, all owners of North Sacramento lands. The proposed line will be 30 miles in length.

OAKLAND, CAL.—Articles of incorporation of the National Power Company, with a capitalization of $10,000,000, and in which a number of east bay city capitalists are interested, have been filed. The purpose for which the corporation is formed to deal in electric power and to acquire water rights for the generation of electricity. Oakland is named as the principal place of business, and the corporation is to exist for a term of fifty years. The stock is divided into 100,000 shares at a par value of $100 each. Twenty-five shares have already been sold and are held by the five members of the board of directors. These directors are Leon M. Gove, H. L. Breed, Charles Gross, J. E. Bowes and E. A. Herrman, all of Oakland.

SACRAMENTO, CAL.—The consolidation has been filed of the Tidewater & Southern Railroad Company and the Tidewater & Southern Railway Company into the Tidewater Southern Railway Company, with a capital of $5,000,000, of which $2,899,315 is paid up, to finance the construction of a system of electric lines through the San Joaquin Valley. The first named company was formed for the purpose of projecting a line from Stockton to Turlock via Modesto, a distance of 50 miles, and to build a branch line from Atlanta to Ripon, five miles. The last named corporation was organized to build from Turlock to Fresno, 97 miles, and to run branch lines to Los Banos via Newman, to Ceres, to Woods Colony, to Oakdale and to Manteca. The directors of the new company are: Karl C. Brueck, Byron A. Bearce, J. L. Craig, George Schuler, W. G. Wallace, T. J. Wisecarver and Frank A. West, of Stockton; J. A. C ley of Escalon; Ward B. Minturn, Frank Helm and W. M. Giffen of Fresno, M. D. Wood of Merced and Claus Johnson of Turlock.

ILLUMINATION.

FLORENCE, ORE.—G. G. Bushman has made application for an electric light and power franchise in this town.

INGLEWOOD, CAL.—The Inglewood Gas Company has been awarded a franchise to lay gas pipe lines in all public streets of Inglewood at $50,000.

TONOPAH, NEV.—Spontaneous combustion caused the destruction of the plant of the Nevada Gas Company by fire on March 8, the loss being $25,000.

OXNARD, CAL.—A special election is to be held April 5th to vote on question of issuing $30,000 bonds for a municipal lighting system. The bonds are to be of $500 each bearing 5 per cent interest, payable semi-annually on the first of June and the first of December. Two of said bonds shall be payable May 1, 1922, and two on the same date each year thereafter until all are paid.

GLENDALE, CAL.- Sealed proposals will be received for the purchase of electric light bonds in the amount of $30,000. Said bonds are twenty-year serials, 30 in number, each of the den mination of $1000, bearing 5 per cent interest, payable semi-annually on September 1st and March 1st, of each year. Two of said bonds are due on March 1st, 1915, and two on the same date of each year thereafter until all are paid.

FLORENCE, ORE.—At a special election here the vote was 48 to 8 in favor of granting to G. G. Bushman, of Sheridan, a franchise to maintain an electric lighting and power plant at this place. The franchise is for 25 years, and is not exclusive. Construction work will be begun soon and the plant will be read to furnish light by September. The plant will have a maximum lighting power of 100 kilowatt units. The town of Florence reserved a right to purchase the plant at any time after ten years from the date of the franchise.

KLAMATH FALLS, ORE.- The dispute between the city and the Klamath Falls Light & Water Company, as to the price of city lighting has been settled by the corporation getting the victory. Some weeks ago the council, on motion of Councilman G. W. Whit, chairman of the finance committee adopted a resolution to pay but 3½c instead of 5c per candle power. The bills of the company were rendered at 5c without regard to action of the council. There has been no contract between the city and the company and the latter was unwilling to make any concession in price unless there was a definite contract specifying a minimum candle power to be used by the city.

ANTIOCH, CAL.—Gas for light and fuel will be supplied to the cities of the north central section of the county by July of this year, according to the plans of Van E. Britton, promoter of the Contra Costa County Gas Company. Franchises for the laying of mains have already been secured from Antioch, Pittsburg and Martinez, and negotiations are in progress with Concord. The plans of the company include the construction of large trunk mains connecting the cities with the manufacturing plant which will be situated at Pittsburg. Construction work on the plant will begin about April with a large force of men. At the same time the laying of mains will be begun in Martinez and Antioch.

TRANSMISSION.

PRIEST RAPIDS, WASH. The Pacific Power Company is contemplating the erection of a large dam here to generate electric power.

SEATTLE, WASH.—Bills have been presented to the City Council for the construction of a steam power plant on Lake Union for the city lighting department.

BELLINGHAM, WASH.—The Board of County Commissioners granted the Whatcom County Railway & Light Company a franchise to build a high power transmission line over the Guide Meridian road to the boundary, there to connect with the Western Canada Power Company.

JACKSON, CAL.—The General Electric Power Company has deeded to the Mokelumne River Power Company five locations covering 53,000 inches of water, three reservoir sites and one power house site. The deed follows a mix-up that occurred after the big power project had been launched by Promoter B. T. Bruce. Extensive litigation was promised.

WASHINGTON, D. C.—After charges had been made that a powerful lobby was at work to procure the adoption of the bill, the House has defeated, 98 to 27, a measure permitting the Hydroelectric Company, a water power corporation, to lay a pipe line across part of the Mono National forest reservation in California. Those opposed to the bill declared it affected the laws governing the National domain and would result in virtually nullifying them. The "water power" trust, it was charged, was behind the legislation.

PLACERVILLE, CAL.—Approximately $100,000 will be expended and 150 men will be employed by the Western States Gas & Electric Company on the work in this county that will take five months to complete. M. McCalman, engineer of construction for the county, is recruiting his force here. The company has a flume six feet wide which carries five feet of water. This flume is seven miles long and is eight years old. It will be practically rebuilt. This will require 1,000,000 feet of lumber. Considerable work will be done at the dam. The two miles of ditch will be dredged and new retaining walls put in.

BREMERTON, WASH.—Power for the navy yard will soon be supplied by the Olympic Power Company, now constructing a plant on the Elwha River near Port Angeles. In addition to its plans for the navy yard, the company is now negotiating with the Bremerton-Charleston Light & Power Company for furnishing electricity in Bremerton, Charleston and Manetto. The Elwha River plant will be in operation next month and the company promises its power lines will reach Bremerton in July. Final arrangements for furnishing power to the government here were completed recently at Washington by Thomas T. Aldwell for the company and the Secretary of the Navy.

CHICAGO, ILL. Samuel Insull and H. M. Byllesby, heads of a local syndicate, have concluded details of the purchase of 40,000 shares or $4,000,000 of the common stock of the Pacific Gas & Electric Company of San Francisco. The price paid is understood to have been around 62½. The outlay involved is about $2,500,000. The stock was sold by the estate of N. W. Halsey. It appears that Insull and his asociates have been buying up the common stock of the Pacific Gas & Electric Company over a considerable period, with a view of gaining a substantial foothold in the gas, electric and power companies of the Pacific Coast. The plans are rather ambitious and the purchase of these shares is merely a start.

SAN JOSE, CAL.—The borrowing of $100,000 is contemplated in the action taken recently by the San Jose Terminal Railway Company for the completion of the electric line between San Jose and Port Alviso and for the steamer line between Alviso and San Francisco. A certificate of the creation of a bonded indebtedness was filed this morning in the office of the county clerk by the company, which was recently organized in this city. The corporation will issue 5 per cent 20 year bonds for $1,000,000 of a denomination of $1000, secured by the capital and holdings. The firm was incorporated for $2,500,000, and $1,512,525 has been subscribed. The directors are Hugh Center, H. J. Gardner, John A. Mehling, J. J. Mahoney and H. H. McCloskey.

TRANSPORTATION.

SALEM, ORE.—Contracts for building a depot for the Oregon Electric Railway will be let in a few days, and work will begin soon as awarded.

PORTLAND, ORE.—The Southern Pacific has authorized an expenditure of $500,000 within the next three months in the work of electrification of its west side lines and work on its new east side freight facilities.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII — SAN FRANCISCO, MARCH 30, 1912 — NUMBER 13

A MODERN MUNICIPAL WATER WORKS

Among the many municipal water supply systems which have been installed recently in the smaller towns of California, that of the city of Corning is worthy of discussion as being a well designed typical plant. The town of Corning has a population of about 2,000, and the system is planned to give reliable service to these, to give adequate fire protection to property, and to conveniently allow future additions.

The supply of water is obtained from three bored wells at an average depth of 150 ft., and cased with 10 in. diameter double No. 16 gauge galvanized well casing. They are situated about 50 ft. apart, so that each will be out of the zones of influence of the others. A combined flow of approximately 2000 gals. per min. is obtained, the water being clear, fairly soft and of pleasant taste. When full quantity of water is being pumped the water level will be reduced from the normal of 8 to about 20 ft. The top of each well casing terminates in a concrete pit, 3 ft. in diameter and 10 ft. deep, this being the same depth as the pump pit. Separate 6 in. suction pipe runs horizontally from the bottom of each well pit and connects with a gate valve inside of pump pit to an 8 in. suction manifold from which the pumps take their supply. Any well, therefore, can be put into or out of service at will from inside the pump house. The suction pipes extend 35 ft. down into each well, creating a tendency to draw from the lower gravel strata rather than from the upper.

The pump house is a fire-proof structure, the walls being of brick and the roof of corrugated iron, so that there is no possibility of interruption of service being caused by fire. The house surmounts the pump pit, which is 18 ft. by 28 ft. and 10 ft. deep. The walls are 12 in. thick of concrete reinforced, and thoroughly water-proofed with a layer of felt in the concrete. On the bottom of this pit set the pumping units. This places the pumps at the water level of the wells so that there is no suction left, which is a condition desirable for the best operation of centrifugal pumps.

Corning Pumping Plant and Tank.

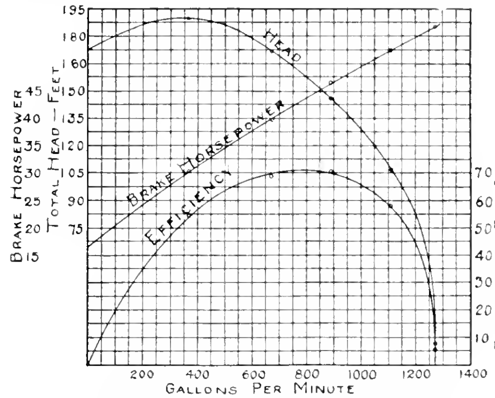
The general service pumping unit consists of an Alberger 6 in. 2-stage, turbine type, centrifugal pump, direct connected to, and mounted on a common cast iron base with a General Electric induction motor, operating at a constant speed of 1200 r.p.m. The pump embodies all the features of the most modern and approved design, including bronze impellers and water passages, ring oiling bearings, water sealed stuffing boxes, and water cooled thrust bearing, so that the upkeep and attention required are practically nil.

The motor is of the squirrel cage type, rated at 50 h.p., with an overload capacity of 25 per cent for two hours, and operates on 2200 volt, 3-phase, 60 cycle current. The only wearing part of such a motor is the ring oiling bearing on the shaft, and the upkeep is negligible.

The normal rating of the unit is a delivery of 800 gals. per min. against a total head of 150 ft. with a pump efficiency of 68 per cent. Under test this efficiency was exceeded by 3 per cent, as shown by curves. The pump may discharge equally well into the tank or into the mains. By reference to the curves, it will

be seen that the characteristics of the pump are such that at no point over the entire range of discharge can the pressure exceed the normal by more than 15 per cent. The pump is absolutely automatic in this respect, and no dangerous pressure can possibly be developed on the water mains. By studying the power curve it will be seen that under no conditions can the load on the motor exceed the normal by more than 25 per cent, so that the motor and other electrical equipment can never be loaded above their overload capacity. It will thus be seen that such a unit is absolutely fool-proof, without the aid of relief valves or other protecting devices.

The fire service pumping unit consists of an Alberger 8 in. 3-stage underwriters turbine fire pump.



Characteristic Curve Alberger 6 in. Two-Stage Turbine Pump Operating at Constant Speed 1160 r.p.m.

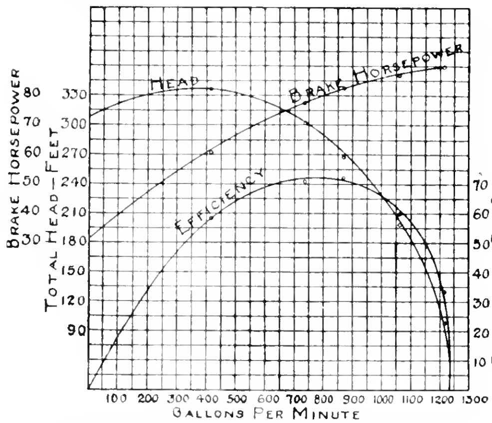
driven by motor operating at a synchronous speed of 1200 r.p.m., the general design of the unit being in all respects similar to that of the service unit.

The motor is rated at 100 h.p., with overload capacity of 25 per cent for two hours.

The normal rating of this unit is to deliver 800 gals. per min. against a total head of 125 lb. per sq. in. (290 ft. head water), with a pump efficiency of 70 per cent (73 per cent by test). This pump has characteristics similar to those of the service pumps, and may discharge into either mains or tank. By studying the curve it will be seen that the pump will throw 3 1/5 good fire streams at the normal rated head of 125 lb., or if required 2 good streams at 145 lb., or 4 good streams at 105 lb., or 1200 gals. per min. or 50 per cent capacity increase into the tank at 65 lb. pressure; all automatically. Such flexibility is of great advantage in fighting fires, and it will be readily seen that it would be practically impossible to obtain these results with any type of plunger pump. The efficiency of this pump, 73 per cent, while not quite as high as would be shown by a triplex pump under test, would be maintained in actual service, whereas leaky valves, poorly packed stuffing boxes and general wear would reduce the efficiency of the triplex to a much lower figure.

A 5 by 5 in. geared plunger pump is provided to discharge all drainage from a small sump in the corner of the pump pit and is to be used in emergency for priming the centrifugal pumps. A 3 h.p., 110-volt, 3-phase, belt driven, induction motor operates this outfit.

Electrical energy at 22,000 volts is available from two companies, and connection is made to both through a double throw oil switch in the pump house, thus insuring continuity of service, which from the standpoint of fire protection at least is important. Independent oil switches and starting compensators for each motor are mounted on slate panels on the pump pit wall. Transformers to step down the electrical energy supply from a voltage of 22,000 to 2200 are located outside of the pump house.



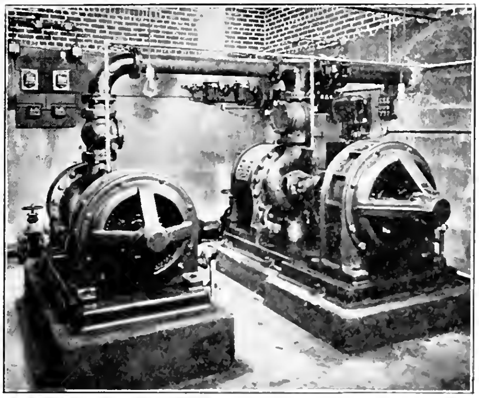
Characteristic Curve Alberger 800 r.p.m. Underwriters Turbine Fire Pump, Operating at Constant Speed 1160 r.p.m.

To provide an adequate reserve supply of water at all times, a 100,000 gallon tank on a 100-foot tower has been constructed, the entire structure being of steel. Each of the four legs of the tower rests upon concrete footings, having 12 ft. by 12 ft. bearing area. On these is supported the tank, which is 22 ft. in diameter, 28 ft. deep, with hemispherical bottom 11 ft. radius. Surmounting the roof is a conical roof, which in addition to keeping out birds, dust, etc., gives a pleasing, finished appearance to the structure.

In the design of the distributing system the three important considerations given attention were: 1st, the delivery of water to all parts of the town without undue loss of pressure; 2d, flexibility and consequent reliability, and 3d, possibility of future extensions.

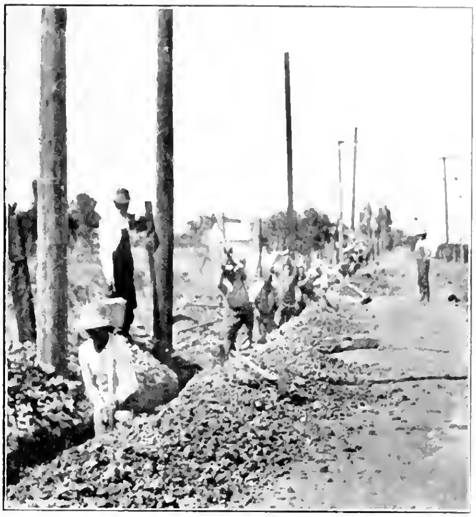
To avoid long lines of small pipe which do not fulfill any of the above conditions an 8 in. circulating loop is run around the main section of town, and the area thus inclosed is again divided into four parts by 8 in. cross town mains. The 8 in. discharge main from the pumps to the tank crosses this loop line at right angles so that by means of 4 gate valves, one on each side of the cross mains, tank and pump can be connected as desired. Four-inch lines extend down the various streets and alleys between these 8 in. mains. All lines in the central part of town, therefore, receive supply from two directions and since all runs are valved, any section may be cut out without interruption of service to the other sections. Also by this

arrangement all 4 in. runs are comparatively short and excessive loss of pressure is prevented. In the layout of the system in the outer parts of town the same principles were, as far as practicable, observed,



Motor Driven Pumps.

viz: circulating loops and no long runs of small pipe. Hydrants to meet the requirements of fire underwriters are liberally located throughout the city. The appropriation available for this work limited the selection of pipe to steel, and steel vasing with lead joints was adopted. This was asphalt dipped at the factory and carefully retouched after being laid, so



Laying Pipe.

reasonable life may be expected. The system comprises approximately 2,000 ft. of 10 in. pipe, 1200 ft of 8 in. pipe, 14 ft. of 6 in. pipe, 22,000 ft. of 4 in. pipe, together with valves, hydrants and fittings. The cost of the entire installation was about $50,000. P. J. Newton was the engineer in charge of the work for the city of Corning, and C. F. Braun & Co., mechanical engineers and contractors, of San Francisco, were contractors for the entire work.

THERMOMETER CORRECTIONS.

In general, all corrections are determined for total immersion, that is, for the condition where both bulb and stem are at the same temperature. If, however, the stem emerges into space, either warmer or cooler than the bulb, a stem correction must be applied to the observed reading in addition to the one given in the accompanying table.

This so-called stem correction is often important in the case of thermometers used for differential temperature measurements, as is calorimetry.

In this case, the correction may be computed from the following formula involving the difference of the initial and final reading:

$$\text{Correction} = Kd\ (T_1 + T_2 - S - t)\ \text{where}$$

K = factor for relative expansion of glass and mercury, 0.00015 for Centigrade thermometers, and 0.000085 Fahrenheit thermometers.

d = $T_2 - T_1$, where T_1 and T_2 are the initial and final readings.

S = scale reading to which the thermometer is immersed.

t = temperature of emergent stem, measured by means of an auxiliary thermometer.

This correction must be applied (added if +, subtracted if −) to the difference of the readings to give the true difference of temperature.

For Example. Suppose the thermometer was immersed to its 65° mark; its initial reading, T_1, was 67°; its final reading, T_2, was 87°; and the stem temperature was 75°. Then the correction is 0.000085 × 20 (67 + 87 − 65 − 75) = .02. The difference between T_1 and T_2, each corrected from the accompanying table, is 20.05°. The true difference between the initial and final temperatures is $T_2 - T_1$ + correction, 86.98 − 66.93 + .02 = 20.07°.

MAXIMUM DEMAND RATE SCHEDULE AT PORTLAND.

The Portland Railway, Light & Power Company has announced a new rate schedule effective after July 1, 1912, based on the consumer's maximum demand. The first 6 per cent of maximum lighting consumption is to be charged at 9 cents per kw. hour, the next 6 per cent at 7 cents and the excess over 12 per cent at 4 cents. Discounts for quantity will be allowed at the rate of 1 cent per kw. hour for monthly consumption in excess of 1000 kw. hours, with an additional 1 cent discount per kw. hour for monthly consumption in excess of 3000 kw. hours.

The power rates for installations of moderate size is to be 7 cents for the first 4 per cent, 5 cents for the next 4 per cent and 2 cents for the excess over 8 per cent. A discount for quantity will be allowed at the rate of 1 cent per kw. hour for monthly consumption in excess of 1500 kw. hours. For wholesale power the rate will be $1.25 per kilowatt of demand per month plus the following charges per kw. hour delivered:

First	1000	K.W.H.	at	2c	Next	16,000	K.W.H.	at	8	Mills
Next	2000	K.W.H.	at	1½c	Next	32,000	K.W.H.	at	7	Mills
Next	4000	K.W.H.	at	1¼c	Next	64,000	K.W.H.	at	6	Mills
Next	8000	K.W.H.	at	1c	Over	127,000	K.W.H.	at	5	Mills

ELEMENTS OF HYDRAULIC ENGINEERING

DEVELOPMENT OF THE TURBINE.

(Continued)

BY GEO. J. HENRY, Jr.

The further development of the Fourneyron turbine was taken up by Boyden in New England and the mills of that section were extensively equipped with Boyden's wheels during the period from 1844 to 1860. See Fig. 11. These turbines were of the radial outward flow type.

The Borda wheel, previously described, suggests the form of turbine later introduced by Henschel in 1837, but further developed and introduced by and now generally known by the name of Jonval. Its use

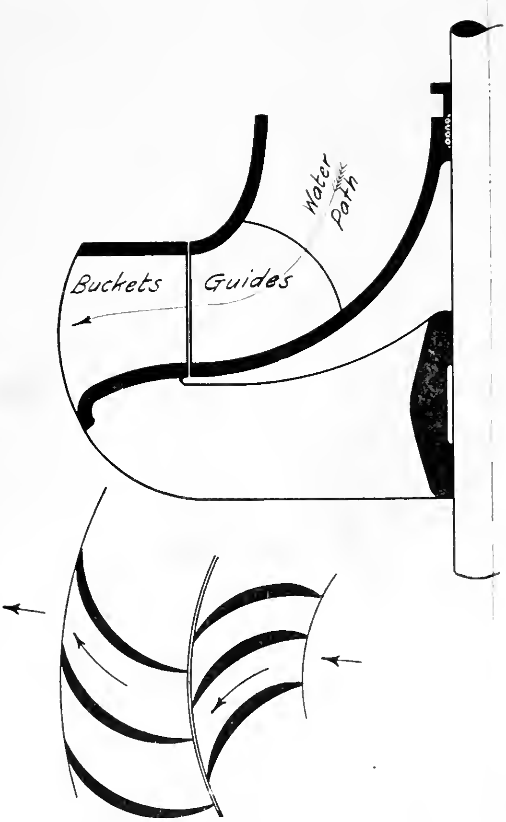


Fig. 11. Boyden Type of Fourneyron Turbine, Radial Outward Flow.

in this country was due mostly to the efforts of Morris & Geyelin of Philadelphia about 1855 and shortly thereafter. It is what is known as a parallel downward flow turbine and is shown diagramatically in Fig. 12.

Quite a few installations of Girard turbines have been made and up to about 10 years ago this type seemed to be gaining quite a foothold. Although the principles of the Girard turbine appear quite simple, and from the standpoint of mathematics the runner and guides appear quite efficient, there are a number of mechanical difficulties which preclude its satisfac-

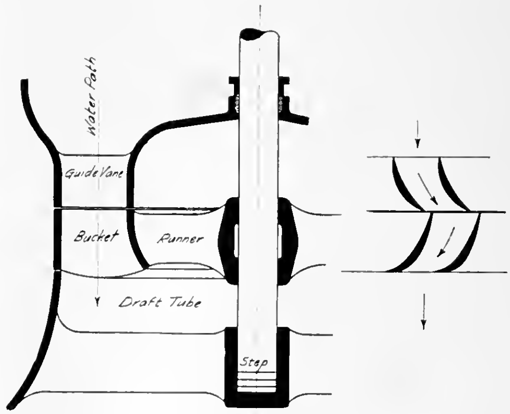


Fig. 12. Jonval Type of Turbine, Parallel Downward Flow

tory application in most cases. The Girard is properly speaking an impulse wheel although generally spoken of as a turbine, probably because of its European origin. It is shown diagramatically in Fig. 13.

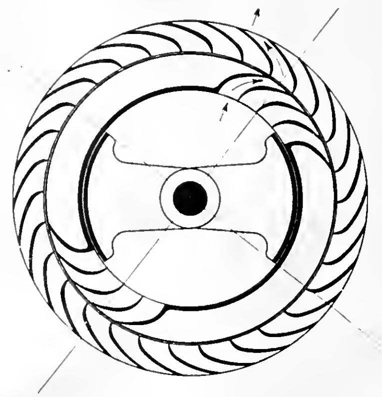


Fig. 13. Girard Type Turbine, With Center Water Entrance.

Considering any pair of guides and buckets and the water action through them, the efficiency should be quite equal to that of the Fourneyron, but this turbine was especially designed for high heads and therefore but a comparatively few water passages were used around the circumference. The gate, by partial rotation, cuts out of action one or more of

the guide passages, after which the buckets must fill with water or air or by the vacuum effect, eddy currents will ensue disastrous to the wearing qualities, efficiency and regulation.

The gate is usually arranged to control a series of inlets on each side, thus, in a measure, balancing the water thrust on the guide ring and runner. But, as the pressure is not constant around the circle, there is a tendency to deform the circular shapes. Under high pressure and large sizes this is very great. The strains in the gate sectors are also severe and the friction between the gate and guide ring such as to make a powerful governor necessary. Even then the movement is not positive and accurate, bringing about a probable hunting effect in the governor action in its effort to make the gates register accurately. As the water does not enter the guide passages radially over the edges of the gate sectors its velocity component in the direction of gate movement also makes necessary a large power capacity in the governor.

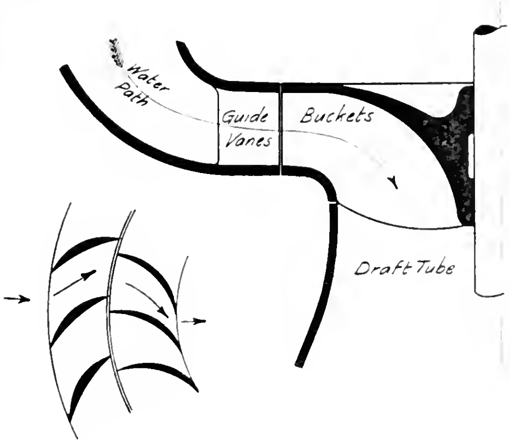


Fig. 14. Francis Type of Turbine, Radical Inward Flow

The reduced area of the water passages in approaching the guides imposed by the limitation of wheel diameter, frequently introduces considerable loss. The discharge chamber, where the velocity should be low, must also be quite large and surround the entire wheel, making the vacuum more difficult to maintain, and compelling that most of the working parts be inside.

It is due mostly to these structural limitations that the Girard wheel has found so little favorable application. Likewise the readiness with which they may be and have been overcome in the modern design of the Francis turbine has secured so favorable a reception for the latter.

The Francis Turbine.

In the radial inward flow type, which is now being so extensively used under the name of the Francis turbine the water enters from the outside, passing radially through the buckets and turning axially in its passage while still in the runner, or immediately on its discharge therefrom as shown in Fig. 14. The inward flow feature of this turbine was patented by Samuel D. Howd in 1836. But as the water cannot be discharged tangentially because of interference with other approaching buckets and on account of the considerable velocity retained in the water discharged from the inside edge of the buckets, this form has not been extensively used alone but has been combined with the axial flow feature to make the modern Francis runner. It will be noted that the direction of water flow in the Girard wheel mentioned above is just the reverse of that in this wheel.

The earlier forms of turbine wheels were generally mounted on vertical shafts and the wheels set in the bottom of penstocks of wood and in some of the later and larger installations of concrete. This form of construction required much less machine work,

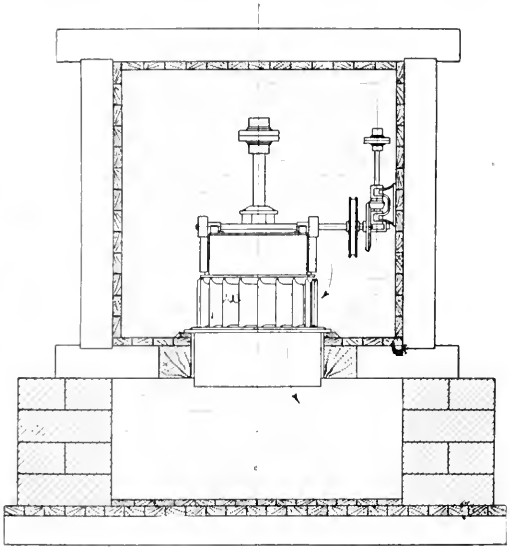


Fig. 15

which was indeed usually limited to that found in an ordinary foundry, and the balance of the work was done at the site where the power was to be developed. See Fig. 15.

Only in recent years in this country has the entire turbine unit, consisting of the runner, the casing, shaft and bearings, gate rigging and governor apparatus all been designed and built in a scientific manner by one engineering organization and high class machine works and there has been a strong tendency toward horizontal shafts and the elimination of gears or other forms of transmission.

This course has concentrated experience and experiment in channels where it has been most readily available for application to further building and perfecting of turbines and has resulted in establishing turbine practice in America on a scientific basis.

Prime Mover Efficiencies.

Based on the potential energy in nature's supply, the modern high pressure Francis turbine and best forms of tangential wheel installations afford a higher

percentage of energy transformed from the primary source into useful work than any other recognized commercial prime mover.

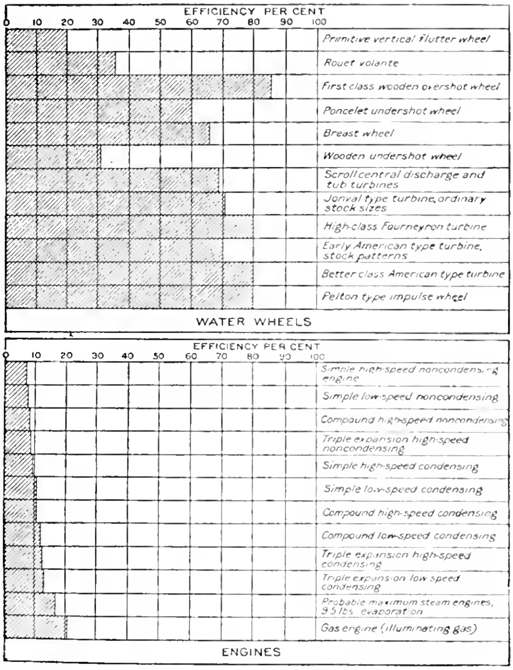


Fig. 16. Comparison of Efficiencies of Various Types of Prime Movers.

A comparison of the efficiencies obtained with various types of water wheels and steam engines as reported by Robt. E. Horton of the U. S. Geological Survey in 1906 may prove of interest as shown in Fig. 16. But this would be somewhat misleading in the case of an hydroelectric plant unless the effect of the

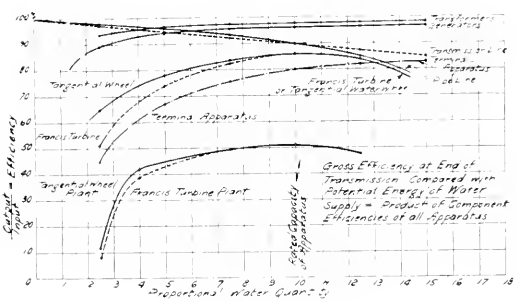


Fig. 17.

station load factor and the transformation and transmission losses taken into account. The losses at fractional loads in the water wheel and associated apparatus would have a material influence on the values given in this table and an approximation of what may be expected is given in Fig. 17. The losses in a modern well equipped steam plant will occur about as follows:

	Per cent.
Energy units in oil or coal.	100
Energy delivered at engine throttle.	40 to 50
Energy rejected to condenser less energy recovered.	30 to 35
Mechanical energy delivered on engine shaft	10 to 15

This may be readily seen by the fact that it is a very high grade steam plant that will deliver 250 kw. hours from a barrel of oil which contains 336 pounds of oil and 18,500 B.t.u. per pound. An average barrel of good oil therefore contains 6,216,000 B.t.u. and as 3412 B.t.u. correspond with a kw. hour we have 1820 kw. hours theoretically in one barrel of fuel oil, which, divided by the 250, obtained gives 13.7 per cent efficiency for the combined steam and electric generator. Allowing 95 per cent as the efficiency of the electrical apparatus we have 14.4 per cent as the gross efficiency of the steam plant.

In considering these figures, however, it must be borne in mind that the mechanical efficiency of the steam engine as a machine is high and that the principal losses are inherently thermal and in no way attributable to the mechanical design of the engine or steam turbine itself, however directly associated they may be with it.

The possibilities of some other forms of heat engines, while having some points to recommend them and having from time to time gained the enthusiastic support of engineers, have never been able to materially encroach on the steam engine field.

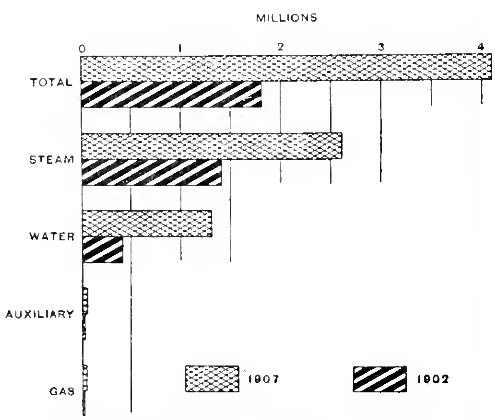
The following figures from the census of 1905 and 1907 may be of interest:

Table I.

	1905	1900	1890	1880	1870
	Owned and rented power			Owned power only.	
Steam power	[illegible]	8,140,533	4,662,029	2,185,458	1,215,711
Increase	33%	74.6%	113.3%	79.8%	
Water power	1,647,969	1,454,229	1,263,343	1,225,379	1,130,431
Increase	[illegible]	15.1%	3.1%	8.4%	
Electric power	[illegible]	193,223	15,569		
Increase	[illegible]	1,068%			

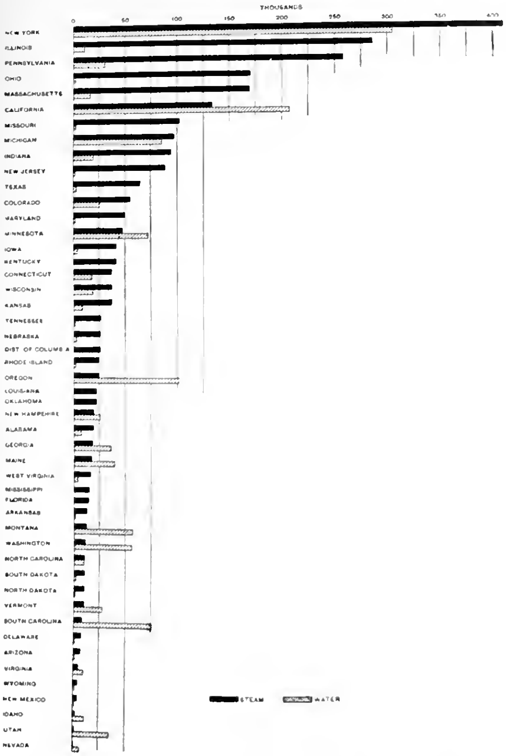
These statistics are reported by the U. S. Census Bureau in Bulletin No. 88, 1907, and in a special report on central stations. "The statistics in Table 1

TABLE II.



Millions of Horsepower Installed in United States. Central Stations in Steam and Water Power Plants—1907.

TABLE III.



(40)

Thousands of Horsepower in Steam and Water Power Central Stations Arranged by States in the Order of Their Relative Importance.

can hardly be considered as accurate, as water power transmitted and utilized electrically is reported elsewhere as electric power by manufacturing establishments."

"Steam has contributed more than any other kind of power to the great increase, 1,247,509 horsepower, in the primary power of central stations, and the steam turbine, which was first reported separately in this industry at the census of 1907, has become a very important factor in the electrical generating equipment. Water is used as the primary power in a constantly increasing number of stations, and the power of the wheels increased by 910,615 horsepower during the five years ending with 1907. Although the greatest absolute increase was shown for steam power, in percentage of increase, it was surpassed by both gas and water power. The percentages are: Steam power 90.4 per cent; water power, 207.7 per cent; and gas power 358.3 per cent."

The figures are here quoted as indicating rather the rate of growth in power and the strong tendency to electrical power use, in the original development of which water power comes in for a large share. Electric transmission did not come into existence until about 1895 and for twenty years before, the growth of cities following the line of least resistance in transportation facilities rather discouraged the development of the isolated water power in favor of the steam engine.

Analagous to the losses associated with the steam engine we have the head losses applicable in water wheel practice and we might with equal justice charge up the reservoir, canal or flume losses of leakage, seepage and evaporation after the water is taken from its natural channel. These being almost constant, however, are not usually considered in this way but appear as increased cost of development of the power per unit delivered at the power house. The losses in the conduits and in fact up to the water wheels, while nearly constant under any fixed load for a particular plant, vary greatly between different plants, although they usually represent only a small percentage of the total power involved. Fig. 17 is given for the purpose of making this clearer and must not be considered other than as a general approximation.

It is obvious that if we are dealing with a low head development and must have a long flume for the water supply, say 10 miles, and have a drop of 125 ft. surveyed and a slope in the flume of 1 in 2500 this corresponds with a constant loss of 21 per cent due to the slope only and results in amortization charges that must be carried by the 104 ft. remaining. Losses also at the pipe inlet and due to pipe friction will probably further reduce this to 100 ft. effective at the water wheels.

The high efficiencies of turbine water wheels, while for many years obtainable under laboratory conditions as in the Holyoke testing flume and on small size sample runners, were often not found to exist when the runner was assembled in its casing and put into commercial operation, and especially was the efficiency found to be low when operated at partial gate. Improvements in the approach passages to the runner and discharge passages and draft tubes have been of greater importance in recent years than in the runner itself. And it will be seen later that the same also applies in tangential wheel practice.

Influences Affecting Turbine Design.

The use of the spiral casing, the form of the wicket gates, and the changing of the water direction on a minimum degree of curvature and at gradually increasing velocities until it enters the runner and gradually reducing velocities during its descent through the draft-tube mark the principal steps in the general design; and combined with a careful study of the mechanical elements involved have put the Francis turbine on its present high plane of excellence.

The advent of electrical measurements has greatly facilitated this by enabling the turbines to be tested in place and up to full gate capacity, thus enabling the purchaser to definitely determine just what he was getting and the manufacturer to "sift the chaff from the wheat" and further improve each consecutive piece of apparatus.

The interests of electric transmission companies, whose primary object was of course the marketing of electric energy largely in competition with existing steam or other hydraulic plants, early came to demand a high efficiency from the apparatus, as this meant

additional power; the gross plant efficiency being in fact the proportional measure of the amount of power the company could market from a given investment. Also most important was it that customers be satisfied with the electric power service supplied them by the transmission company. The user would not be responsible for interruption in the service, however caused, and such interruptions became a direct charge in dollars against the power company. If therefore an additional expenditure by the power company would secure more kilowatts to sell from a given investment or reduce the investment in development for a given electric power output, or would secure apparatus

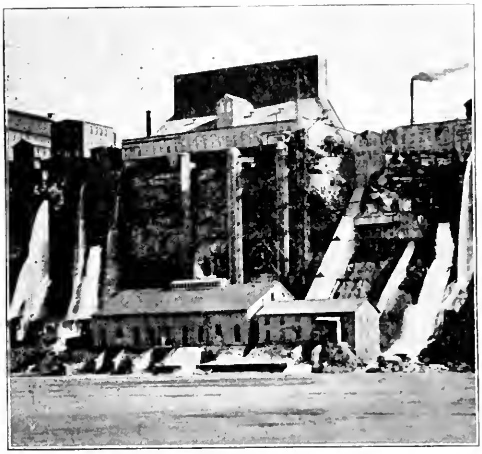


Fig. 18. Plant of Niagara Falls Hydraulic & Manufacturing Company.

susceptible of more reliable operation, then such extra expense was a logical investment in the purchase of their apparatus. The path was sometimes blocked by water wheel builders not having an engineering organization or shop equipment adequate to meet the demands, and high class builders were frequently confronted with competition with inferior products, and often too the purchasers were lacking in the proper knowledge or discernment to appreciate the value of the superior product involving higher first cost. But the general trend during the last twenty or thirty years has been rapid along the lines of improvement.

A good example of the replacement of older turbines by higher class modern apparatus and electric transmission is that which has taken place in some of the plants at Niagara Falls. In the lower foreground of Fig. 18 is shown the plant of the Niagara Falls Hydraulic & Manufacturing Company, where an output of 35,000 h.p. was obtained from the canal that originally (with earlier turbines) supplied but 10,000 h.p. The canal was increased 50 per cent in depth, but by utilizing the entire head, 210 ft. in this case, more than double the output was easily obtained. This is a case of intelligent engineering application. It is probable that not more than a few per cent efficiency difference, if any, would have been shown in any Holyoke test of the runners of the new stations over the older ones, and yet the conservation of the investment in canal, pipes and building per unit of power, thus made available, is at once apparent.

It is then, not only to the lines of the turbine runner or the shape of the tangential wheel bucket that we must give careful study but in the associated parts and general adaptation to existing conditions of the entire apparatus if we would crown our power development with success.

Choice of Turbine.

One of the most frequent questions asked is, "What is the best type of turbine for me to use?" and a little thought will at once indicate the necessity for a full understanding of the requirements and local conditions before this question can be intelligently answered. The quantity of power to supply to the proposed market with a careful study of the daily and yearly load curve; the probable future needs; is the water supply sufficient to meet this with or without storage throughout the year; under what head can the water be utilized with the most economical headworks, canal, piping and power house, and will we be able to utilize a draft tube within safe draft limits and still keep the power house well above high water? Only a careful engineering study of these preliminary points will enable the engineer to advise intelligently.

This reduces the problem to the point of determining the power, capacity, speed and number of units, and the type to be adopted.

During the past few years it has become good practice to build Francis turbines for higher heads and the limit does not seem to have been approached as yet. Where ten years ago large units were seldom built for 200 ft. head, we find today 500 ft. is even more common. This has been brought about by a gradual increase and careful study of the results at each consecutive step.

The capacity of a single unit ten or twelve years ago was 500 to 1000 h.p. whereas today it is 10,000 kw. with a strong tendency to still further increase the size.

A third variable that the water wheel designer has had to contend with has been the constantly increasing speeds of electric machinery.

The development of the steam turbine has placed upon the market a large number of high speed standand design generators whose first cost was much less per unit of power on account of these high speeds and reduced weight of material.

The purchaser of hydraulic apparatus is therefore interested in obtaining the highest head, the largest capacity (and therefore the fewest units in the power house) and the highest speed units consistent with good practice and the economical use of the units with reference to the daily load curve.

It is safe to say that among manufacturers there are some who will recommend higher speeds or heads and offer higher guarantees in their anxiety to sell apparatus than would other conservative builders, and such recommendations must not be confused with any ability on their part to build better apparatus or that they are better able to meet such promises or secure

better operating results. It is not the automobile that would be guaranteed for the highest racing speed that necessarily would meet such speed under commercial conditions or which was cheapest in first purchase price that would be the best investment for the purchaser, nor would one that burned the minimum gasoline under test—but one that meets the commercial speed and has the least gasoline consumption over several thousand miles, the least tire wear and above all the minimum total maintenance and depreciation.

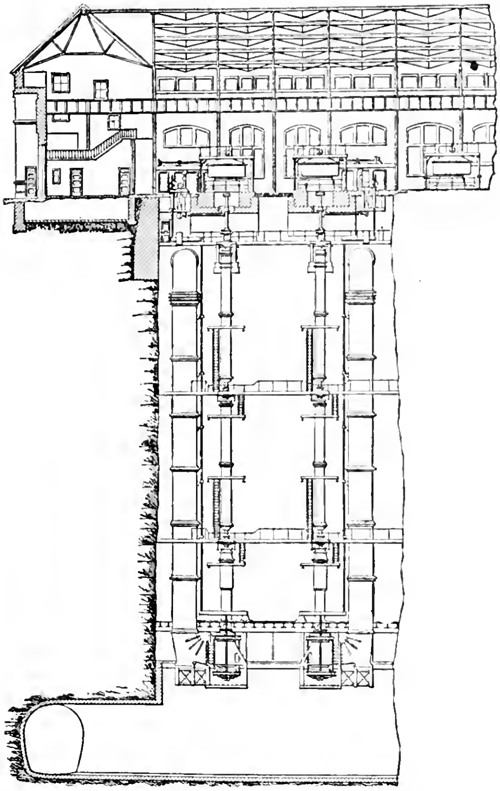


Fig. 19. The First Installation of the Cataract Construction Co. at Niagara Falls, 1892-3.

Thus it is with turbines. The greatest number of kilowatt hours from the water available with the least fixed charges and maintenance, and the best regulation is what the purchaser wants, and also rigidity of the apparatus and the proper distribution of material (the heaviest equipment is not by any means necessarily the safest or best) is essential to service quality as well as efficiency and output.

The cost of the water wheel apparatus is as mentioned before, but a very small fraction of the total investment in the plant, and the entire investment is for its success so absolutely dependent on the success of the water wheel apparatus that for a few per cent of the total investment the very best construction instead of an inferior one can be purchased, thus obtaining the best permanent insurance for a small first cost only; such purchase is certainly the wise one to make.

As to the type of turbine unit as regards the arrangement of the several parts, casing, runner, shaft, bearings, draft tube there are of course limitations in each instance, but generally speaking there are several different ways in which each form of mounting can be put together.

Today, Francis turbine practice is tending rapidly toward the elimination of the flume and cylindrical casing mounted wheels and toward the almost universal use of spiral casings. Also the tendency toward the entire elimination of working parts from within the water chamber, that is all the gate operating mechanism and bearings must be exposed for lubrication, care and inspection, and needless to say the usual effort is to direct connect the driving and driven machinery. A discussion of the details of construction of the several types, their limitations and advantages, will be given in a later article.

Between the building of the Cataract Construction Company's plant in 1893 and the present day, the progress has been most rapid and it has been characterized by the replacing to a very large degree of other forms of turbine by the improved forms of the Francis. For example in the first installation by the Cataract Construction Company at Niagara for the electrical transmission of a considerable power, the board of engineers made use of the Fourneyron type of wheel which gave a very high efficiency, but the loss of draft, the deep and expensive wheel pit and the maintenance of the long wheel shaft (See Fig. 19), together with other considerations has led later companies to adopt a different design. In the case of the Ontario Power Company this is evident in setting the power house near the river below the falls. Aside from the damage possible from high water in the Niagara River (and which occurred once since the plant was installed) this gives a more convenient and efficient arrangement of apparatus.

Although it is very difficult to foresee all the accidents that may occur, it is of course one of the functions of the hydraulic engineer to anticipate and guard against them as far as possible.

BRITISH COLUMBIA TELEPHONE RATES.

There has been much discussion in Victoria in regard to the proposed increase of telephone charges by the British Columbia Telephone Company.

The new rates for Victoria and Vancouver to go in effect April 1, 1912, are as follows: For unlimited telephone service to business houses a monthly rate of $5 net will be charged, an increase of $1 per month; for the man of small business who has few calls a rate of $3 for the first 100 outgoing calls will be made, and for each additional call a charge of 2 cents. The residence rates are $3 for individual and $2 for two-party lines, the same as before.

The long-distance charges are: From Victoria to Nanaimo, for first two minutes, 50 cents; each additional minute, 20 cents each. From Victoria to Cumberland, 90 cents for two minutes, and 40 cents each additional minute. From Victoria to Vancouver, 60 cents per minute.

WESTERN LAWS OF ELECTRICITY AND WATER

EARLY DEVELOPMENT OF THE DOCTRINE OF APPROPRIATION.

BY A. E. CHANDLER.[1]

The doctrine of appropriation is one recognized in the law of waters as governing a class of rights markedly distinct from the riparian rights of the common law. It grew out of the occupancy of the public domain during the mining period and is not accepted outside of the western mining and irrigation States. Although of so recent origin as far as our own people are concerned, the following quotation from Clough v. Wing (2 Ariz. 371) shows its long standing in America:

And the right to appropriate and use water for irrigation has been recognized longer than history, and since earlier times than tradition. Evidences of it are to be found all over Arizona and New Mexico in the ancient canals of a prehistoric people, who once composed a dense and highly civilized population. These canals are now plainly marked, and some modern canals follow the track and use the work of this forgotten people. The native tribes, the Pimas and Papogos and other pueblo Indians, now, as they for generations have done, appropriate and use the waters of these streams in husbandry, and sacredly recognize the rights acquired by long use, and no right of a riparian owner is thought of. The only right in water is found in the right to conduct the same through their canals to their fields, there to use the same in irrigation. The same was found to prevail in Mexico among the Aztecs, the Toltecs, the Yaquis, and other tribes at the time of the conquest, and remained undisturbed in the jurisprudence of that country until now. Clough v. Wing, 17 Pac. 453.

As was to be expected from the great rush to the gold fields following the discovery in January, 1848, legal controversies early arose not only in regard to the mining claims but also in regard to the ditches and water rights used in connection therewith. One of the very early cases often quoted is Irwin v. Phillips (5 Cal. 140) decided in 1855 and the following extract from the opinion clearly shows the necessity for the doctrine of prior appropriation:

Courts are bound to take notice of the political and social condition of the country which they judicially rule. In this State the larger part of the territory consists of mineral lands, nearly the whole of which are the property of the public. No right of intent of disposition of these lands has been shown either by the United States or the State governments, and with the exception of certain State regulations, very limited in their character, a system has been permitted to grow up by the voluntary *occupation* of the mineral region has been *tacitly assented to* by the one government, and heartily *encouraged* by the expressed legislative policy of the other. If there are, as must be admitted, many things connected with this system, which are crude and undigested, and subject to fluctuation and dispute, there are still some which a universal sense of necessity and propriety have so firmly fixed as that *they have come to be looked upon as having the force and effect of res judicata.* Among these the most important are the rights of miners to be protected in the possession of their selected localities, and the rights of those who, by prior appropriation, have taken the waters from their natural beds, and by costly artificial works have conducted them for miles over mountains and ravines, to supply the necessities of gold diggers, and without which the most important interests of the mineral region would remain without development. So fully recognized have become those rights, that, without any specific legislation conferring or confirming them, they are alluded to and spoken of in various acts of the legislature in the same manner as if they were rights which had been *vested* by the most distinct expression of the will of the lawmakers * * * This simply goes to prove what is the purpose of the argument, that however much the policy of the State, as indicated by her legislation, has conferred the privilege to work the mines, it has equally conferred the right to divert the streams from their natural channels, and as these two rights stand upon an equal footing, when they conflict, they must be decided by the fact of priority, upon the maxim of equity, *"Qui prior est in tempore, potior est in jure."*

Elsewhere in the above mentioned opinion it is stated:

It must be premised that it is admitted on all sides that the mining claims in controversy, and the lands through which the stream runs and through which the canal passes, are a part of the public domain, to which there is no claim of private proprietorship.

The miners and others were but trespassers on the public domain as Congress had passed no legislation recognizing their claims. It is not surprising that a movement gained weight in the Eastern States to have the government assert its ownership to the mines and ditches and other developed works on the public lands. As far as the West is concerned, therefore, the then critical situation was happily relieved by the passage of the famous Act of 1866 which is now Section 2339 of the Revised Statutes of the United States and reads as follows:

Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws and decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

In 1870 the section which is now Section 2340 of the Revised Statutes and which is generally construed with Section 2339, was passed. It is as follows:

All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights as may have been acquired under or recognized by the preceding section.

It is to be noted that by the two sections above quoted not only were the water rights which had vested and accrued recognized, but also the rights of way for ditches and reservoirs in connection therewith.

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The first noteworthy judicial construction of the Act of 1866 was by the Supreme Court of Nevada in the case of Vansickle v. Haines (7 Nev. 249) decided in January, 1872. Both parties were the owners in fee of their respective lands. Haines' patent was dated December 28, 1864, and long prior thereto Vansickle had diverted part of the waters of Daggett Creek which diversion was interfered with by Haines in December, 1867, under the claim of riparian ownership. The lower court rendered judgment in favor of Vansickle on the grounds of prior appropriation, but the Supreme Court held that such rights of appropriation were inferior to the riparian rights of Haines and reversed the decision. In reference to the Act of 1866, the Supreme Court said:

The Act of Congress of July, 1866, if it shows anything, shows that no diversion had previously been authorized, for if it had whence the necessity of passing the Act, which appears simply to have been adopted to protect those who at that time were diverting water from its natural channel?

Doubtless, all patents issued, or titles acquired from the United States, since July, 1866, are obtained subject to the rights existing at that time, but this is a different case, for if the appellant has any right to the water, he acquired it by the patent issued to him two years before that time, and with which, therefore, Congress could not interfere.

On May 28, 1872, the Federal Circuit Court for Nevada decided the case of Union Mill & Mining Co. v. Ferris (2 Saw. 176). The mill company, as a riparian owner, brought the action to enjoin Ferris and other farmers in the Upper Carson Valley from diverting the waters of Carson River. Regarding the Act of 1866 the court said:

For seventeen years prior to 1866, the mineral land of California and Nevada had been occupied by the citizens of the United States, without objection on the part of the government. Canals and ditches were dug at this time, often at great expense, over the public lands, and the water of the streams diverted by these means for mining and other purposes. Local customs grew up in the mining districts, by common consent, and by rules adopted at miners' meetings for governing the location, recording and working of mining claims in the particular mining district. Possessory rights to public lands, mining claims and water were regulated by State statutes, and enforced by the State courts. * * *

But the Act is prospective in its operation, and cannot be construed so as to divert a part of an estate granted before its passage. If it be admitted that Congress has the power to divest a vested right by giving a statute a retrospective operation, that interpretation will never be adopted without absolute necessity.

To appreciate the seriousness of the two Nevada decisions above mentioned, it must be remembered that the construction therein given, one who received patent prior to July, 1866, for riparian land could enjoin diversions above him to non-riparian lands no matter how long such diversions had existed; and also that any one who secured patent prior to July, 1866, to land crossed by a ditch became the owner of such ditch, or at least could stop its operation.

Fortunately for the early investors the Supreme Court of the United States did not adopt the Nevada Court's view, as is clearly shown in the case of Broder v. Natoma Water & Mining Company (101 U. S. 274) decided October, 1879. The water company had constructed a ditch at an expense of about $200,000 in 1853 on lands then public. Part of the land crossed was within the Central Pacific Railroad grant under the Act of 1864 and Broder became the owner thereof and brought the action to have the canal declared a nuisance and to recover $12,000 damages on account of its maintenance on the land. In construing the provisions of the Act of 1866 in its bearing upon the case, the Court said:

In reference to his lands held under conveyance from the railroad company, it might be a question of some difficulty whether the right was so far vested in that company before the passage of this Act of 1866, that the latter would be ineffectual as regards these lands. But we not think that the defendant is under the necessity of relying on that statute.

It is the established doctrine of this court that rights of miners, who had taken possession of mines and worked and developed them, and the rights of persons who had constructed canals and ditches to be used in making operations and for purposes of agricultural irrigation, in the region where such artificial use of the water was an absolute necessity, are rights which the government had, by its conduct, recognized and encouraged and was bound to protect, before the passage of the Act of 1866. We are of opinion that the section of the Act which we have quoted was rather a voluntary *recognition of a pre-existing right of possession*, constituting a valid claim to its continued use, than the establishment of a new one. This subject has so recently received our attention, and the grounds on which this construction rests are so well set forth in the following cases, that they will be relied on without further argument.

The Broder v. Natoma Water Company decision has continued to be the accepted construction of the Act of 1866, and what uncertainty may have arisen from the Nevada decisions was thus removed.

As the first appropriations on the public domain were by the miners, it became the custom to initiate water rights by posting notices similar to those used for the mineral claims. The fact that the notice in the case of the water claim could hardly be seen except by accident and was therefore not like the mining notice which could be seen by all prospectors passing the mineral claim, did not appeal to the early miners and has failed to impress our California legislators early or late. The water claims posted in accordance with custom were recorded in the county records long prior to any legislation authorizing or requiring such recordation.

Reference has been made to Irwin v. Phillips and the rule of prior appropriation. In the following year, 1856, the case of Conger v. Weaver (6 Cal. 548) was decided and established, as between claimants on government land, the doctrine of relation in regard to appropriations in the following words:

But, from the nature of these works, it is evident that it requires time to complete them, and from their extent, in some instances, it would require much time; and the question now arises, at what point of time does the right commence, so as to protect the undertaker from the subsequent settlements or enterprises of other persons. If it does not commence until the canal is completed, then the license is valueless, for after nearly the whole work has been done, any one, actuated by malice or self-interest, may prevent its accomplishment, any small squatter settlement might effectively destroy it.

But I apprehend that, in granting the license which we have presumed for the purpose before us, the State did not intend that it should be turned into so vain a thing, but designed that it should be effectual for the object in view; and it conse-

quently follows that the same rule must be applied here to protect this right as in any other.

So, in the case of constructing canals, under the license from the State, the survey of the ground, planting stakes along the line, and actually commencing and diligently pursuing the work, is as much possession as the nature of the subject will admit, and forms a series of acts of ownership which must be conclusive of the right.

In an earlier case, Eddy v. Simpson (3 Cal. 252) decided in 1853, it was said:

It is laid down by our law writers, that the right of property in water is usufructuary, and consists not so much of the fluid itself as the advantage of its use. * * * The right is not in the *corpus* of the water, and only continues with its possession.

The general principles of prior appropriation were thus established by the California Supreme Court in the fifties. As new cases arose they were enlarged upon and strengthened, so that when the legislature did finally act upon this subject in 1872 the sections adopted were but declaratory of the existing law. The sections then enacted are 1410 to 1422 of the Civil Code and still remain, with slight amendments, the only statutory provisions on appropriation of water, with the exception of special legislation regarding appropriations for power purposes adopted at the special session of 1911.

Section 1415, providing for notices of appropriation, and Section 1416, providing for prosecution of the work, are as follows:

SECTION 1415. *Notice of Appropriation.* A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:

1. That he claims the water there flowing to the extent of (giving the number) inches measured under a four-inch pressure;
2. The purposes for which he claims it, and the place of intended use;
3. The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.

A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.

After filing such copy for record, the place of intended diversion or the place of intended use or the means by which it is intended to divert the water, may be changed by the person posting said notice or his assigns, if others are not injured by such change. This provision applies to notices already filed as well as to notices hereafter filed.

SECTION 1416. Within sixty days after the notice is posted, the claimant must commence the excavation or construction of the works in which he intends to divert the water, or the survey, road or trail building, necessarily incident thereto, and must prosecute the work diligently and uninterruptedly to completion, unless temporarily interrupted by snows or rain; provided, that if the erection of a dam has been recommended by the California Debris Commission at or near the place where it is intended to divert the water, the claimant shall have sixty days after the completion of such dam in which to commence the excavation or construction of the works in which he intends to divert the water; provided, that whenever any city and county. * * * (A proviso added in 1911 to relieve cities and towns from the necessity of prosecuting the construction work with the diligence required of other appropriators.)

Section 1418 provides that the water right will relate back to the time of posting notice on compliance with above rules.

Section 1422 provides that when the "place of intended diversion or any part of the route" is within a national park, forest reserve or other reservation, the claimant shall have sixty days from the date of approval of his application to occupy such national park, etc., within which to commence work as provided in Section 1416.

As stated above, under the doctrine of relation laid down in Conger v. Weaver, the right to appropriate water, after the completion of the diversion works with reasonable diligence, dated back to the first steps taken in regard thereto. The Statute, in Sec. 1418, fixes this first step as the posting of the notice (Sec. 1415). It is now well settled (Wells v. Mantes, 99 Cal. 583) that the Statute need not be followed in order to make a valid appropriation in California (except for power purposes under the 1911 Statute which is not under consideration in the present article), but by failure to follow the Statute the benefit of the doctrine of relation is lost and the right dates back only to the completion of the work. There is therefore nothing to be gained and much to be lost by not following the Statute.

As is shown by Sections 1415 and 1416 there is no public officer in California concerned in the form of contents of the notice of appropriation and the consequent construction work. Our county records abound in notices under which no construction or survey work was ever done. Such notices are not worthy of the slightest consideration and are in no way "clouds upon the title," as is often claimed. Unless the construction work is begun and continued with reasonable diligence to completion, as provided in the Statute no right accrues. The use of the water alone fixes the right.

In regard to the statements required by the three subdivisions of Sec. 1415, practically any notice, regardless of form, giving the number of inches claimed, the purposes, place of use, means of diversion and size of conduit, will suffice. In the records are found examples of empty generalities as well as some of refined details. As an illustration of how little need be stated, to be accepted as sufficient by the Supreme Court, the following notice from the case of De Wolfskill v. Smith (5 Cal. App. 175) is quoted.

Notice of Appropriation of Water. Take notice that the undersigned claims fifteen hundred inches of water measured under a four-inch pressure flowing from and at the wells bored by the San Jacinto Oil Company on the land which would be the northwest quarter of section four, township three south, range two west, San Bernardino meridian, if said land were surveyed by the United States, and I intend to divert said water at the three several points where this notice is posted, to wit, at each of said wells bored by the San Jacinto Oil Company.

I intend to use said water for domestic and irrigation purposes on the land which was known as the Rancho San Jacinto Nuevo and the Morena, Lakeview and Alesandro Colonies and adjoining lands in the county of Riverside, State of California.

I intend to divert said water by means of ditches of sufficient capacity to carry same, leading from each of said points.

Dated the thirteenth day of October, 1902.

ELENA P. DE WOLFSKILL.

Witness: DAVID G. DE WOLFSKILL.

ARGUMENT FOR FAIR RATE MAKING.

BY A. F. HOCKENBEAMER.

The basis of all borrowing is credit. Credit in our industry depends upon earnings and earnings are absolutely determined by the rates we are allowed to charge for gas and electricity. This inevitably leads to the deduction that public service corporations must be allowed rates that will permit them to earn, not merely a bare interest return upon their investment, but a sufficient return to establish the credit they must have in order to attract the capital necessary to the continuance of their business. That this is the conclusion reached by the Railroad Securities Commission appointed under the authority of Section 16 of the Act to create the United States Commerce Court, approved June 18th, 1910, is very clear from the report made by this Commission to President Taft under date of November 1st, 1911. This commission answers the question "What Constitutes a Reasonable Return" in the following words:

"We hear much about a reasonable return on capital. A reasonable return is one which under honest accounting and responsible management will attract the amount of investors' money needed for the development of our railroad facilities. More than this is an unnecessary public burden. Less than this means a check to railroad construction and to the development of traffic. Where the investment is secure, a reasonable return is a rate which approximates the rate of interest which prevails in other lines of industry. Where the future is uncertain the investor demands, and is justified in demanding, a chance of added profit to compensate for his risk. We cannot secure the immense amount of capital needed unless we make profits and risks commensurate. If rates are going to be reduced whenever dividends exceed current rates if interest, investors will seek other fields where the hazard is less or the opportunity greater. In no event can we expect railroads to be developed merely to pay their owners such a return as they could have obtained by the purchase of investment securities which do not involve the hazards of construction or the risks of operation."

The Chairman of the Railroad Securities Commission, Mr. Arthur T. Hadley, is the President of Yale University and one of the leading political economists of the United States. The other members, Frederick N. Judson, Frederick Strauss, Walter L. Fisher and B. H. Meyer are all men of national prominence and recognized ability, and their conclusions are worthy of the utmost confidence.

What does it cost the Pacific Gas & Electric Company to raise new capital? As already stated, it is necessary to its very existence to raise from five to ten million dollars every year. Although this money is expended in California, it cannot be raised locally and the company, when it wants to enlarge its plants, is required to knock at the same doors as the City of San Francisco when it wants to sell bonds for municipal improvements. In doing so, the securities offered for sale must compete in their quality and in their appeal to the investor with securities of thousands of other corporations. Money cannot, as with governments and municipalities, be legislated into its treasury. Its securities must conform to the standards established in the investment world or they will not command the confidence of investors, who will invest their money in the many other securities that are being offered that do conform to these standards and that do inspire their confidence. Fortunately, the Pacific Gas & Electric Company has, during the past four years, been able to obtain the confidence of investors in an increasing degree. One extensive piece of financing was undertaken in the latter part of 1907. That money, which was expended for new construction, additions, betterments and improvements is today costing this company about 11 per cent. It could not at that time be obtained at lower cost owing to the severe business depression and the impairment of our credit because of the severe losses sustained in the San Francisco fire of April, 1906. This illustrates one of the vicissitudes of our business. This high-priced money is still in our plants. To deny it a return now would be confiscation.

Within the last few months we have reorganized our financial system in such a way that we are at this time able to obtain the funds for meeting the growth of our business, not only at a materially lower rate, but upon as favorable terms as any other large public service corporation similarly situated and engaged in the same lines of business and, as a matter of fact we have within recent months, effected the sale of a large block of our bonds upon the terms which are generally regarded as extremely favorable to the company. These bonds were issued under our general and refunding mortgage. This mortgage was placed upon our entire property on December 1st, 1911. It is so designed that the company may from time to time, as it needs money for new construction, or for the payment of maturing bonds of underlying issues, sell bonds secured by this mortgage until the total of the bonds so issued aggregates $150,000,000. In fixing this limit the board of directors anticipated the needs of the company for possibly fifteen years. This mortgage, before it was finally executed by the company, was submitted to the scrutiny of three of the leading investment banking houses in the United States, and the provisions it contains are only such as, in the opinion of these banking houses, would enable the company to sell its bonds. Using as a basis our recent sale of bonds issued under this mortgage, this company, in order to finance itself with these bonds, must absolutely be allowed to earn upon its investments as follows:

(a) Actual interest rate upon the money........ 6.10%

(b) Under the terms of the mortgage no bonds may be issued unless the Company earns at least one and one-half times the interest on the new bonds as well as upon all underlying bonds, which necessitates our earning from our investment 50% of the 5% face rate of the bonds, or.................................. 2.50%

Total rate which we must earn upon our investment in order to finance ourselves through the sale of these bonds 8.60%

There are collateral requirements in the mortgage which must be met out of earnings, or which must be financed through the sale of junior securities at an even greater cost than above, namely:

(c) For every bond we have outstanding we must set aside a fund of 1% per annum as a sinking fund for the retirement of our funded debt. This imposes a burden upon us at this time in excess of $700,000 per year, and, as a practical matter, may be assumed to add to the percentage of earnings above shown an additional 1.00%

(d) Under the terms of the mortgage for every $1,000 expended for new construction, we are allowed to issue bonds only to the amount of $900. The difference of $100 must be met either out of earnings or through the sale of some junior security. Based upon our estimated construction for the next five years, this will impose an additional burden upon us of $500,000 per year or, as a practical matter, an addition to the above percentage of required earnings of approximately...... .70%

Total 10.30%

In view of the foregoing facts and based upon many years experience in corporate financing, it is my opinion that unless this company can earn at least ten per cent upon its investment, over and above operating expenses and a reasonable allowance for depreciation, it will be unable to find the necessary capital to carry on the enterprise.

THE MERIT AND DEMERIT SYSTEM.

One large hydroelectric corporation operating in central California has specially ordered that all suggestions coming up through the separate departments bear the signature of the individual in whose brain the idea originated in order that proper credit may be given.

Now comes the Pacific Electric Railway Company that operates the great interurban electric system out of Los Angeles. In order to create an esprit d'corps among its workers and especially encourage faithfulness and ambition among all their trainmen, yardmen and towermen, a merit and demerit system has just been introduced by this corporation. In the following will be found the important details:

The practice of administering discipline by actual suspension is discontinued and substituted by a system of record suspension, under which the employe is allowed to continue at work, and demerit marks, corresponding in number as far as practicable to the number of days employes are kept off duty is noted against each employe's record in the office of the superintendent. The accumulation of seventy-five demerits result automatically in discharge from the service. When fifty demerits have accrued, the employe is called to the office and shown the lines along which he must improve if he expects to be retained. No suspension is recorded wthout notice to the person affected and an opportunity given for explanation. Any employe may have access to his own record at any time. If a discharged employe feels there are extenuating circumstances, he may appeal personally to the superintendent, and if his re-instatement is approved by proper authority, the debit against his record will commence at fifty demerits. The second accumulation of seventy-five demerits will permanently retire the employe.

Credit will be allowed for meritorious service, commendable acts, deeds of heroism and loyalty, good judgment in emergencies, etc., by a like method of merit marks, the number of which will cancel a corresponding number of demerits. If at the time the employe's record is clear, the credit will apply against a future debit.

Record bulletins will be issued by the superintendent monthly, showing for educational purposes a brief account of each case resulting in discipline, and stating when necessary how it could have been avoided, but giving no names or information identifying the person at fault.

This system is inaugurated with a view to furthering the welfare of the employe in that it will not work financial hardship upon him, and to securing a higher state of efficiency in that it will act as an incentive to meritorious service, which it has not been practicable heretofore to recognize in a substantial way.

Below is given a list of acts of omission or commission for summary discharge and for demerits and merits. This is subject to modification as conditions may require from time to time.

Dischargeable Offences.

Gross carelessness or disobedience of orders resulting in accident.
Dishonesty or false statements.
Insubordination or disloyalty.
Fighting on duty.
Intoxication or frequenting saloons.
Sleeping on duty.
Incompetency or unsatisfactory service.
Failure to flag railroad crossings.
Unsatisfactory references.

Merits.

Clear service record six months	15
Clear service record one year	30
Detecting bogus transportation	10
Meritorious service in avoiding accident, or unusual assistance or good judgment in emergencies, or any commendable act out of the strict line of duty	5 to 30

Demerits.

Missing run or late—	
First time	Reprimand
Second time	5
Third time	10
Discourtesy	10 to 30
Altercation with passengers	5
Smoking on duty, passenger cars	10
Reading on duty	5
Inattention to duty or unnecessary conversation	5
Careless operation: (See foot note.)	
Resulting in accidents narrowly averted	5 to 15
Resulting in minor accidents	20 to 30
Failure to observe train order or check register, or observe schedule of superior trains, or running railroad crossing, not resulting in accident	30
Passing fixed danger signals not resulting in accident	30
Failure to report accidents, defects, etc.	10
Talking to outsiders about accidents or criticizing management or policy of the company	10
Lack of neatness	5 to 10
Careless handling and registration of fares and tickets	5 to 20
Signals imperfectly given and respected	5 to 15
Signals imperfectly displayed	10
Violating speed restrictions	5 to 20
Running ahead of schedule	5 to 20
Making poor reports:	
First time	Reprimand
Second time	5
Rough handling of freight or equipment	5 to 10

Foot Note. "Careless operation" includes among other things:
Careless flagging.
Splitting switch.
Allowing air to leak
Leaving car unprotected.
Moving trains on improper signals or without signals.
Running derails.
Leaving switch open.
Flattening wheel unnecessarily.

A GAS PRODUCER CREMATORY.

The following letter is one of the best bits of imaginative humor that has been written along mechanical lines, being a copy of a letter read at a district agents' meeting of the Southern California Edison Company of Los Angeles, by H. N. Sessions, commercial engineer, to whom we are indebted:

Dear Sir:—I herewith disclose an inspiration that has come to me, and I wish your assistance in putting my plans into practice. I have conceived the idea of building what in a few words might be termed a gas producer crematory. Its purpose is to conserve not only the ashes of the body, but every other constituent as well, such as gas gastric juice, etc., and all poisons that may be present.

My first conception is contained in the book of James, paragraph 4, verse 14: "For what is your life? It is even a

vapor that appeareth for a little time and then vanishes away." I believe this vanishing vapor mentioned in the scripture is gas.

Gas is a late word, a contraction of Geist, meaning ghost or spirit in German. This information has aroused the strong instinct I have always had of gas and its relationship to the human being. We all must dread being interred, I do, and the present system of cremation is almost as unsatisfactory when we consider that only the ashes which represent a small part of us is all that is accounted for.

It requires 900,000 British thermal units to convert the average person; this heat varying somewhat for a hardened criminal or a Good Government worker, as the case may be, but I can guarantee that with my process their departure from this world will in contrast make their future existence, wherever it may be, seem cool and delightful.

My idea is to install a bench gas generator where the body can be smelted. It only requires 1,500 cubic feet of gas to bring the retort up to heat and cremate one body which at a dollar per thousand, is only $1.50, but with my plan, however, gas will cost nothing, as I will presently demonstrate.

The eminent Dr. Sulphume of Massachusetts in his "Gas Treatise" fixes the volume of gas contained in the average body at approximately 4000 cu. ft., the calorific value of which is 600 of John Bull's standard in each foot. His tests were conducted on a number of Boston beings, and he has allowed a liberal margin for leakage, etc. The candle power of the gas is high or low, it goes up or down, depending on the age and sex of the fuel.

Now then, if Dr. Sulphume is correct, each body will furnish 4,000 cu. ft; 1,500 cu. ft. of this can be used for the regeneration of the next departing soul, and the balance or 2,500 cu. ft. can be conserved and disposed of in many useful and novel ways. If the relatives or heirs of the departed do not wish his gas after he has been scrubbed and purified, he can be blown into the storage tanks to float freely among a peaceful crowd of gasified strangers, without having his pockets picked. On the other hand he can be squeezed like presto-lyte under a high pressure, and delivered to his sorrowful widow, for example in a miniature bronze statuary receptacle, along with his powder. His gas can escape and burn like half a candle at a small pet cock, furnishing a wee flicker of light hope to his dear ones—or his gas with his ashes can be tossed to the winds; his ashes to fall to earth, but his vapor to ascend up, only to hang in a stratum with other comrades of equal weight or specific gravity.

The profit of such an undertaking is dead sure. Fuel will cost nothing, as the gas derived from one body (4,000 feet) is more than ample to cremate the next. The entire operating expense will be offset by the by-products alone; the gold and silver dental work will smelt into a button ranging from $3.00 to $10.00 bullion value.

I wish to organize the parent company at Oakland, to be called the Oakland Gas Undertaking Company, with capital stock of $200,000, composed of 20,000 shares at $10.00 par value each.

The stock will all be sold at par value, and shall be non-transferable, non-assessable and non-redeemable. No stockholders shall be allowed to possess more than one share, which will net him dividends of 25 per cent on a conservative basis, and entitle him to free cremation at death, when the earning power of his certificate shall cease, as it must be burned with him. These stock certificates will be similar to the Consols of England, and will give consolation at least—at last of a decent finish. The full 20,000 shares must be taken up by as many people of Oakland; this will raise $200,000, which is sufficient to make an erection of the plant and purchase patent rights. I estimate that in fifty years all, or nearly all, of the stockholders and stock shall be gone, which means that the outstanding stock will diminish each year to the extent of $20,000 and the dividends on the remaining stock will necessarily increase proportionately, so that the individuals who part last with their lives and stock will reap the greatest benefit; hence this will be an opportunity for the most youthful to take advantage immediately. When the stock and holders of stock shall have become extinct, the institution might be dedicated to Oakland.

Yours truly, PEAT SHALE.

Cow Hollow, Alameda, Co., Cal.

ELECTRIC RAILWAY ACCIDENT PREVENTION AT SEATTLE.

For the purpose of discussing ways and means of educating the public and the employes of the Seattle Electric Company in the prevention of accidents on street cars, the safety committee of the Seattle Electric Company gave a complimentary banquet at the Butler hotel last week. Plans were discussed to organize the local car barns for the prevention of accidents.

George Carson, general claim agent, was the chairman of the evening and officiated as toastmaster. The following spoke on subjects relative to means of averting street car accidents: A. J. Falkner, "The Legal Side of the Accident Question"; H. S. Elliott, "Relations of Public Service Corporations to the Public"; A. L. Kempster, "How the Safety Committee Can Prevent Accidents"; Dr. Park Weed Willis, "Relations Between the Claim Department and the Medical Department"; W. J. Grambs, "The Lighting Department," and H. T. Edgar on "Co-operation."

WESTERN CODE OF ENGINEERING ETHICS.

The Pacific Association of Consulting Engineers was recently organized with headquarters in San Francisco. It embraces in its charter membership the following engineers, engaged in consulting practice:

A. L. Adams, F. G. Baum, Bernard Bienenfield, W. A. Cattell, C. Derleth, Jr., G. L. Dillman, J. H. Dockweiler, Edwin Duryea Jr., J. D. Galloway, C. E. Grunsky, Wm. Ham Hall, P. E. Harroun, Col. W. E. Heuer, L. J. Hohl, Howard C. Holmes, A. M. Hunt, N. B. Kellogg, C. D. Marx, M. M. O'Shaughnessy, Luther Wagoner, J. H. Wallace, C. B. Wing.

The association is actively urging a decided change in the present system of procuring expert witnesses in the courts. In regard to this phase of its ethics the association has put itself on record as pledged to the following provisions:

2. For the purpose of improving present court procedure in its relation to engineering practice, and for the purpose of increasing the efficiency of the engineering profession as an aid to the settlement of questions in controversy, this association believes it desirable to restrict such engagement as soon as practicable to the following conditions:

a. As a witness when appointed by and compensated through the agency of the court.

b. As court commissioner, referee or other examiner, preferably sitting with an attorney, to take evidence involving engineering questions.

c. As arbitrator appointed by either party to the controversy, or by both parties jointly through the agency of the court or otherwise, and compensated by both parties or jointly.

d. As special adviser to either contestant.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Western Water Rights

There is no more potent inflence in the West for her substantial upbuilding than that of carefully and properly devised laws governing water rights in the various commonwealths of our western empire. Long since the real estate man in full realization of the inherent blessings of water, sang his pretty song:

"Little drops of water
Added to the sand
Make a heap-a-difference
In the price of land."

But not alone are those directly interested in real estate dependent upon the profitable development and equitable distribution of water. Our mines, our great natural water powers—in fact our very life depends upon the security with which water rights are to be obtained. To obtain security, a careful study of existing laws and court decisions must be made. One should master the doctrine of appropriation as opposed to the riparian doctrine, existing in the older Eastern States. The storage of flood waters and even the intricate decisions of the courts concerning the recovery of percolating waters must be carefully gone into. California, Wyoming, Colorado, Idaho and the other arid States of the West have enacted laws covering the abandonment and forfeiture of water rights. Rights of way over the public domain and questions involving the delicate considerations when interstate streams are to made use of become at times most important. A knowledge of the principles involved in the organization of canal companies and the fixing of water rates is of vital interest to Western men.

The Journal is fortunate in being able to announce to its readers that a series of papers written by A. E. Chandler, will appear in our columns from time to time covering the complete discussion of water rights and their interpretation.

Mr. Chandler has been connected with the U. S. Geological Survey and with the Reclamation Service, Moreover as first State engineer of Nevada, he put into definite form ideas of water control and equitable distribution. By this he showed himself qualified for the duties incumbent upon an engineer in full charge of land and legal matters in the field for the Reclamation Service, the position that he held from 1905 to 1910. These five years spent in passing on water claims throughout the West have given Mr. Chandler a breadth of knowledge and experience in these matters possessed by few other engineers. Mr. Chandler now occupies a position in engineering activity associated with the well known expert, C. E. Gunsky of San Francisco, and at the same time he is associated with the great work in irrigation institutions at the University of California. His writing bears the culture and stamp of the college man and student. It is then with a genuine pleasure that we publish the beginning of this series elsewhere in this issue of the Journal.

The Basis of Western Rate-Fixing

The modern long distance electric power line supported by miles of vertical uprights with their horizontal arms, capped with the beautiful corona effect, which at times appears in modern high tension transmission, appeals to the power plant owner and the consumer alike—not as a series of golden crosses with their crowns of thorns,but rather as miles of burden-bearers threading their way from the high Sierras, Cascades and Rockies into the centers of industry and human activity. These miles of upright supports, transmitting for man's good the subtle forces of the captive water-fall, may almost be imagined to glory within themselves over the joy and the comfort they are about to bring to human society. In the beautiful corona issuing from their fiery tips we almost see a god-given soul rejoicing in this inner realization.

The poetry of hydroelectric development in the West is not, however, to be written in words. A higher, truer poetry—a poetry entuned with the infinite—is to be found in the contemplation of the rise of our western empire and the far-reaching effect the development of our water powers has had in this great work.

Now comes the commission empowered by law to look into the affairs of the great hydroelectric companies. The duties devolving upon the membership of a commission are the highest and yet at the same time the most delicate imaginable. Throughout the West the sound of the builder's hammer is heard on all sides. Capital by the millions is needed each year and we must seek the great money markets of the world for necessary funds. Of necessity, then, we must operate and control our public service corporations in such a fair-minded manner as to ensure our western financial credit remaining equal to the best.

In California the great corporations are laying before the commission their financial minimums in earning capacity—minimums below which credit will be impaired. The argument of the Pacific Gas & Electric Company, found on another page in this issue, is worthy of careful scrutiny. An earning of ten per cent upon its physical valuation investment, over and above operating expenses and a reasonable allowance for depreciation, is asked.

The recent public service commission law of California expresses in no uncertain terms that economies, efficiencies and improvements on the part of the great public service corporations should be encouraged by the commission in every reasonable manner. The gigantic development ahead for the next ten years, to accomplish which every avenue of credit must be kept intact and encourgaed, demands that the various municipal commissions and State commissions weigh with utmost delicacy any proposal to so curtail earnings as to jeopardize the development of western enterprise. Indeed, a lesson is to be learned from Eastern decisions. The New York Commission has put itself on record as not only bound by sentiment but the dictates of justice lead it to express itself in the following emphatic terms:

"Various standards have been suggested for determining the fair rate of return. The one, which in our opinion, is properly applicable to this case is that the rate should be such that investors would be induced to provide funds with which to construct and extend a gas and an electric plant within the area in question. If the State were to fix a rate below this standard, capital could not be secured. If investment were made before the State acted, the original capital might be forced to remain, but additiinal capital could not be secured unless necessary to protect the first outlay."

Let us, then, oil up the slide-rule and find where the credit-keeping minimum is located.

A Western Code of Ethics

The modern consulting engineer in his ethical evolution, like the rotating magnetic field, is ever attempting to catch up with the impelling influences of modern thought and progress. Indeed, the recent action of the Pacific Association of Consulting Engineers, not only entitles that group of experts to be considered as catching up with modern trend of ideas but it may be characterized as leading the march of ethical affairs by a safe and conservative angle of advance.

Of course the true engineer will not allow his opinion to be biased, no matter who may be paying the fee, yet to testify under such conditions certainly puts the consulting engineer in the light of a partisan. Solely for the purpose of aiding in establishing the truth, he is placed on the stand. No sinister motive should ever make him swerve from his high position, nor should he be put to the humiliation of having any one say his opinion was in any measure influenced by the size of the fee to be received or suffer the insinuating glance of the opposing faction which often plainly shows they believe the professional opinion is influenced by the quarter from which the fee is to come.

How much more in keeping with the highest ends to be accomplished would it be for the court to appoint the consulting engineering witness and have him compensated through the agency of the court. As a court commissioner, referee or other examiner preferably sitting with an attorney to take evidence involving delicate engineering questions, the professional consulting engineer would then be entitled to the dignity such a position should command and to the weight such unbiased technical evidence should add to the deliberations and decisions of the court. It is of course within thorough ethical ideals to appear as a special adviser to either contestant, but when evidence is desired upon which to decide the merits of the case, the consulting engineer, eminently qualified for the difficult and delicate questions at issue, would meet his highest field of usefulness by sitting as an arbitrator appointed by both parties jointly through the agency of the court or otherwise, and compensated jointly by both parties to the issue. Such are the high ethical ideals of the Pacific Association of Consulting Engineers and to these ideals may they strictly adhere and may they receive the whole-hearted support from the legal fraternity, which they fully deserve.

PERSONALS.

Jacob Furth, president of the Seattle Electric Company, was at San Francisco this week.

John A. Crombach, an electrical supply dealer of Sacramento, was a recent San Francisco visitor.

W. J. Wallace, right-of-way agent for the Southern California Edison Company is a recent San Francisco visitor.

H. B. Kinney has been appointed superintendent of the northern division of the Great Western Power Company, with headquarters at Santa Rosa, Cal.

J. W. Whistler, hydraulic engineer, has been engaged by the City Council of Pendleton, Ore., to investigate the proposed municipal electric power plant.

E. V. D. Johnson, manager of the Northern California Power Company, is making an inspection of the various hydroelectric plants and transmission lines of the system.

George L. Hoxie, consulting electrical engineer at New York City, has arranged to open a branch office at Los Angeles and has associated with him Meade Goodloe.

G. R. Murphy, manager of the electric storage battery department of Pierson, Roeding & Company, has returned to the San Francisco office after a business trip to Seattle.

D. G. Young, recently joined the electrical sales department of the Allis-Chalmers Company's San Francisco office, after spending some time in the Seattle and Portland offices.

H. C. Goldrick, manager of the Pacific Coast department of the Kellogg Switchboard & Supply Company, of Chicago, has returned to his San Francisco office after visiting Fresno on business.

F. P. Rawson has returned to Seattle after locating a transmission line for the Northwestern Electric Company, to supply power to the Crown Columbia Paper Mills, Camas, Washington.

H. F. Gronen, engineer in charge of construction work at Tacoma's hydroelectric plant, at Nisqually, has been elected commissioner of light and power to fill out the term of Ben J. Weeks, resigned.

E. G. Lorbeer, of the Lorbeer Electric Supply Company of Los Angeles, spent the past week at San Francisco visiting his branch wholesale supply house at 633 Howard street which is being managed by E. G. Alexander.

L. E. Alspaugh, an engineer who has been with the San Francisco office of J. G. White & Co. for the past four months, will report to the firm's New York office April 1st, to take a permanent position in the hydraulic department.

R. P. Perkins, who has been with the Y. M. C. A. as first assistant engineer for the past year has been appointed traveling engineer in the eighteenth lighthouse district with headquarters at the new Customs House, San Francisco.

Charles Blizard, third vice-president of the Electric Storage Battery Company of Philadelphia, and J. L. Woodbridge, the chief engineer of the same corporation, arrived at San Francisco on a tour of the Pacific Coast during the past week.

Garnett Young, manager of the Telephone-Electric Equipment Company, left last Wednesday for a month's Eastern trip in the cause of which he will visit a number of factories. He will attend the annual sales meeting of the National Metal Molding Company at Pittsburg, April 2d, 3d and 4th.

F. B. Gleason, manager of the Western Electric Company's Pacific Coast department, has returned to his San Francisco office after visiting the Portland and Seattle branches.

A. W. Bullard, vice-president and general manager of the Great Western Power Company, made an inspection of the dam-site at Big Meadows, with H. H. Sinclair and F. W. Rollins of Boston, during the past week. Work on the great dam will be prosecuted vigorously during the coming season.

A. C. Sprout and Sidney Sprout, engineers for the California-Oregon Power Company, recently returned to San Francisco from Siskiyou county, where work is soon to be rushed on the new Klamath River development in order to take care of the growing business. Each generating unit will be driven by an 18,600-h.p. water wheel. Bids have been received for one of these units for early delivery and it is understood that two more are to be ordered for installation within a year.

Glenn C. Webster, manager of the engineering department of the National Electric Lamp Association, Cleveland, Ohio, is making a trip through the South Atlantic and Gulf States, where he will visit the principal cities of Tennessee, North and South Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana in the interests of the incandescent lamp industry. A study of the incandescent lamp consumption in the United States, from data recently compiled by Mr. Webster, indicates that the South Atlantic and Gulf States are not keeping pace with other sections of the country. Statistics show that incandescent lamp sales in this section amount to about 28 lamps per 100 inhabitants, or an average of little better than one lamp for every four persons. This is in marked contrast with the one hundred and fifty lamps used per one hundred inhabitants on the Pacific Coast, or with the one lamp per capita used in those States bordering on the Great Lakes. Mr. Webster is deeply interested in the cooperative movement on foot among the men connected with all branches of the electrical industry and is recognized as a leading spirit in the progressive Electrical League of Cleveland. During a recent visit to the Pacific Coast, he participated in the launching of the Electrical Development League of San Francisco and in a similar organization among the members of the electrical fraternity of Los Angeles, Cal.

TRADE NOTES.

Henry H. Thedinga, district sales agent of the Century Electric Company, of St. Louis, recently moved his office to 343 Central building, Seattle, Wash.

The General Electric Company has sold to the Los Angeles Gas & Electric Corporation: One C. C. 4, 125 kw., 2400 r.p.m., 120 (slant) 125 v., horizontal, condensing Curtis turbine generator exciter set for use in connection with a new 5000-kw. turbine generator

The Western Electric Company's Oakland branch, managed by E. A. Crowson, is to be removed from 507 Sixteenth street to a much better store, which has been handsomely fitted up, on the corner of Nineteenth street and Telegraph avenue. A full line of the company's goods will be carried.

The Westinghouse Electric & Manufacturing Company has sold to the Mt. Whitney Power Company two 1750-kw., 2300-volt, 60-cycle, 3-phase generators, which will be direct connected to two Pelton water wheels operating at 300 r.p.m. Also, one 55 kw. water wheel-driven exciter set and one 55-kw. motor generator set.

The second annual banquet of the employees of the Westinghouse interests was held Saturday evening, March 16, at the Fort Pitt Hotel, Pittsburg, Pa. About five hundred of the employees of the various companies located in the Pittsburg district were present, and all agreed that it was the most successful affair of this kind that had ever been held.

A notable order has been secured by the Fort Wayne Electric Works for a number of electric rock drills for use in the Pacific Light & Power Company's new tunnel in the San Gabriel Canyon. The tunnel, 7x4 feet, is being driven through black Gunnison granite, which is extremely hard. It is understood that the low maintenance was the determining factor in choosing these electric drills, after a series of severe tests in competition with air drills of various types.

PORTLAND INSTITUTE MEETING.

The two hundred and seventy-first meeting of the American Institute of Electrical Engineers will be a Pacific Coast meeting held at Portland, Oregon, April 16 to 20, 1912. This meeting will be similar in its scope to those held on the Pacific Coast in San Francisco in 1910 and Los Angeles in 1911. President Gano Dunn will attend this convention and preside over its meetings.

The convention committee consists of F. D. Weber, chairman, Portland, Oregon; H. R. Wakeman, P. Lebenbaum, L. B. Cramer, C. L. Wernicke, W. D. Scott, S. G. McMeen, W. S. Turner, O. B. Coldwell, Portland, Oregon; S. B. Charters, San Francisco, Cal.; A. A. Miller, Seattle, Wash.; F. D. Nims, Vancouver, British Columbia; O. H. Ensign, Los Angeles, California; J. B. Fisken, Spokane, Wash.

Arrangements have been made for reduced fares from all points on the Pacific Coast. These rates will be given under the "certificate plan." The fare will be one and one-third of the regular one-way fare. Members must ask for receipt certificates when purchasing tickets, if the fare exceeds 50 cents "on the going trip." These receipt certificates must be presented for the signature of the secretary of the meeting before same become valid. Complete information may be obtained at any railway ticket office.

Programme.

Tuesday, April 16, 1912.

10:00 a. m.—Registration.

11:00 a. m.—Address of welcome. S. G. McMeen, president Mount Hood Railway & Power Company.

1:30 to 5:30 p. m.—Papers and discussions.

Entertainment During the afternoon a trip to Council Crest for the ladies has been arranged. Tuesday evening there will be held an informal banquet for members and ladies.

Wednesday, April 17, 1912.

9:30 a. m. to 12:00 noon—Papers and discussions.

1:30 to 2:30 p. m.—Papers and discussions.

Entertainment—3:00 p. m.—River trip to Oregon City, visiting plants and points of interest. Evening has been left open

Thursday, April 18, 1912.

9:30 a. m. to 12:00 noon—Papers and discussions.

1:30 to 5:30 p. m.—Papers and discussions.

Entertainment—Auto trip around the city has been arranged for the ladies in the afternoon.

8:00 p. m.—Mr. A. H. Babcock, electrical engineer, Harriman lines, will give a talk on the "Operation of 1200-Volt System of the Southern Pacific Company." This talk will be illustrated by lantern slides.

Friday, April 19, 1912.

8:00 a. m.—All-day excursion to River Mill and Estacada plants of the Portland Railway Light & Power Company and the Bull Run development of the Mount Hood Railway & Power Company.

Lunch will be served at the Estacada Hotel. The ladies may attend this excursion if they so desire.

Friday evening left open.

Saturday, April 20, 1912.

Entertainment.—Trips to substations, steam plants, etc.

Papers.

"Operation of Two Alternating Current Stations Through Parallel Circuits and the Distribution of the Load and Wattless Current Between Them"......By J. W. Welsh

"Air Gap Flux Distribution in Direct Current Machines"... ....By Charles R. Moore

"Principles to Be Considered in Selecting a Water Wheel Unit" ....By. O. B. Coldwell

"Irrigation in the Spokane Valley"..........By L. J. Corbett

"An Underground System and a Few Developments"...... ....By S. B. Clark

"Alternating Current Systems of Underground Distribution" ....By S. J. Lisberger and C. J. Wilson

"Automatic Private Branch Exchange Development in San Francisco" ....By Gerald Deakin

"Long Distance Telephone Transmission on the Pacific Coast" ....By C. A. Turner

"The Design of Telephone Pole Lines for Conditions West of the Rocky Mountains" ....By A. H. Griswold

"The Application of Automatic Selecting Devices to Telephone Multiple Switchboards" ....By A. H. Dyson

"Plant Efficiency" ....By J. D. Ross

"Practical Joint Pole Construction"......By J. E. Macdonald

ELECTRICAL CONTRACTORS' NOTES.

L. R. Boynton of the Central Electric Company spent Tuesday in Sacramento on business.

C. V. Schneider, of the Electric Supply Company of Sacramento, was in San Francisco Saturday.

A. F. Flannigan, an electrical contractor from Stockton, was in San Francisco Monday.

Wiring bids for the Standard Oil Company's new building are to be in by March 29th.

Following is the programme of the National Electrical Contractors' Association in Denver:

July 16—Meeting of board of directors and executive committee.

July 17 First session of convention open to all that attend at 10 a. m. Governor Shaforth of Colorado will deliver an address on "The Resources of Colorado," and he will be followed by two speakers on electrical subjects. Business session, 2 p. m., for members. Ladies and non-members will be given a sightseeing trip. 8 p. m.—Reception and dance. 10 p. m. A rejuvenation of the Sons of Jove.

July 18 Business meetings at 10 a. m. and 2 p. m. At 12:30 the Denver Electric Club will give a dinner to all attending convention. 8 p. m. Annual dinner for everybody, followed by vaudeville show.

July 19—An all-day trip to Corina. Luncheon will be served on the train.

It is up to you to be in Denver the week of July 17th, and the Denver people will see that you don't regret going.

CORRECTION ON WIRING COSTS.

To the Editor: I have read with much interest the article in the Journal, dated March 23d, under the heading "Electrical Contractors' Notes," from the pen of J. N. Pierce of Chicago, and while the figures presented by him are very interesting, they are most certainly misleading, and it is my belief that this method of figuring jobs has to a great extent been the basis of insufficient profits on the part of the electrical contractor.

I think we will all agree that the basis for determining overhead should be sales and not costs, hence, the figures of Mr. Pierce would not give the contractor the 10 per cent profit which he shows him to have earned. The correct figures of the problem submitted should be:

Cost of job..............................	$5000
Overhead 20 per cent on sales = 25 per cent on cost	1250
Cost of job..............................	$6250
Profit 10 per cent..............................	625
Proper bid	$6875

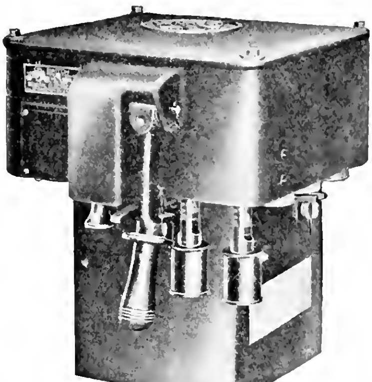
WM. L. GOODWIN.

INDUSTRIAL

A NEW OIL SWITCH FOR INDUSTRIAL APPLICATIONS.

Those who are interested in the applications of electricity in industrial plants such as powder works, coal mines, cement mills, gas works, textile mills and the like, especially where explosive gases or flying inflammable materials are present, will welcome the introduction of a new oil switch which can be satisfactorily used in such locations and under these conditions.

Before designing this switch the conditions of operation in the places enumerated above and the difficulties to be overcome were carefully canvassed with the result that the following qualities were incorporated in the design of the switch:



Automatic Oil Break Switch with Overload, Time Limit and Low Voltage Release.

First: Safety by having all live parts entirely enclosed.

Second: Reliability by constructing the switch so that it can be operated by unskilled operators.

Third: Durability by having the best of mechanical construction.

Fourth: Flexibility by a combination of features adapting it to a wide range of requirements.

This switch is manufactured double and triple pole in capacities up to 300 amperes and 2500 volts, both non-automatic and automatic. The automatic switches are tripped by overload coils connected in series with the line and can be furnished in the following combinations:

First: With overload trip coils, instantaneous or time limit with low voltage release attachment.

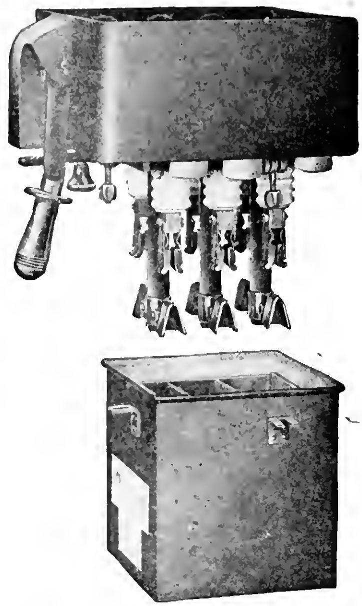
Second: With overload trip coils, instantaneous or time limit without low voltage release attachment.

Third: Low voltage release only.

The switch leads are usually brought out through the sides and bottom of the switch frame but if it is necessary to bring them out at the top, special covers can be provided. These are made in two pieces, one removable to secure access to the interior of the switch without disturbing the wiring, and the other supplied with holes for the leads. Covers can be furnished with porcelain bushings for open wiring; with holes for conduit wiring, or, with holes for bell mouths to take triple conductor cable.

These switches can also be supplied with special covers for mounting a series ammeter on top of the switch to make, in effect, a complete induction motor control outfit, thus dispensing with the usual panel and supports. These covers are also made in two parts. The front half carries a bracket for mounting the ammeter with porcelain bushings for the instrument studs, while the rear half is removable to facilitate making connections to the switch and from the switch to the ammeter. The ammeter is a useful adjunct to the oil switch as it indicates at all times the current taken by the motor and can be used to detect faults in the motor circuit, thus permitting immediate corrections of minor troubles which might otherwise cause a shut down.

Although these switches are practically dust-proof for ordinary conditions, when used in cement mills, etc., extra precautions must be taken to exclude dust, and special gaskets can be furnished which will accomplish this purpose.



Non-Automatic Oil Break Switch.

An interlock can also be supplied so that when the switch is used with induction motors employing resistance for starting or varying the speed the switch cannot be closed unless the resistance is in the "off" position.

In installations where a large number of induction motors are used it is some times desirable to install a locking device in connection with the oil switch so that an operator can shut down the motor to work on a machine and lock the switch. No other person can then start the motor accidently or otherwise, until the first operator, who holds the locking key, is ready and returns the key. An arrangement to accomplish this can be furnished, which consists of a magnetic lock in connection with the low voltage release and a special snap switch with removable key. Special indicating lamps are also used which are lighted when the oil switch is locked open and the key removed from the snap switch. If desired the magnetic lock can be operated from several stations, the removal of the key from any one preventing the starting of the motor until all keys are in place.

These switches are known as the type "F," Form "K-20" and are made by the General Electric Company, Schenectady, New York.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—Globe Telephone Company, $1,000,000, by J. R. Wheat, G. W. Temple, et al.

SAN JOSE, CAL.—The Senorac Power Company, $500,000, by C. P. Anderson, J. F. Tatham, D. M. Burnett and A. L. Brassy.

SAN FRANCISCO, CAL.—The Standard Carbon Products Company has been incorporated by C. L. Hollis, T. A. Johnson and L. T. Mayhew.

SACRAMENTO, CAL.—The Truckee River General Electric Company is a Maine corporation, capitalized at $3,000,000, papers for which have been filed. The directors are residents of Maine.

ASTORIA, ORE.—Articles of incorporation of the Mutual Telephone Company have been filed. The incorporators are W. D. Torrey, A. J. Gragg and I. N. Fleicschner, and capital stock is $2500. They will construct a telephone line from Seaside to Elk Creek.

SACRAMENTO, CAL.—Articles of incorporation have been filed by the Sacramento Interurban Railway, which proposes to construct an electric line connecting Sacramento, Fair Oaks, Orangevale and Roseville. The capital stock is $500,000, with $50,000 subscribed. D. W. Johnston of the North Sacramento Company is the heaviest stockholder. Other directors are M. N. Williamson, Marshal Diggs, Ray C. Waring, A. D. Kidahl, Charles E. Hollister and James F. Elliott, all owners of North Sacramento lands. The proposed line will be 30 miles in length.

SACRAMENTO, CAL.—Incorporation papers for the Mt. Shasta Aqueduct Corporation, capitalized at $10,000,000 with offices at San Francisco have been filed. The purpose is to supply water to cities, develop power sites, etc. The directors named are: Clarence E. Sheets, Oakland; Thomas H. Laine, Berkeley; William L. Hawkins, Joseph P. Kennedy and H. McDonough, San Francisco. Papers also were filed for the National Power Company, capitalized at $10,000,000, with chief offices at Oakland. The directors named are: Leon M. Cave, H. L. Breed, Charles Cross, J. E. Bowers and E. A. Harriman, all of Oakland.

OAKLAND, CAL.—At the organization meeting of the San Francisco-Oakland Terminal Railways, the following officers were elected: E. A. Heron, president; first vice-president, W. R. Alberger; second vice-president, Dennis Searles; directors—E. A. Heron, W. R. Alberger, Dennis Searles, Edward D. Keiffer, W. W. Briggs, B. M. Atken and F. W. Frost; chief counsel, Harmon Bell. After the meeting, President Heron said: "The filling in of the Key Route pier for its entire length and the enlarging of the pier at the western end will be the first work undertaken. This will proceed at once. The trainshed will be enlarged, room being made for additional tracks and ferry slips." An intimation of what the men behind this consolidation expect to do in the next few years was given by the filing of a deed of trust for the terminal properties with the Mechanics' Trust Company of New Jersey preparatory to a bond issue of $30,000,000. What is to be done with this money is not explained, but it is understood that it will be one of the first large issues on which the Railroad Commission, with its enlarged powers, will have to pass The San Francisco-Oakland Terminal Railways will carry on the improvements planned by the various corporations before the merger. This includes the extension of the Key Route lines to San Jose to Richmond and up into Central California. The suburban service of the Oakland Traction Company is to be much improved, while a number of new lines are planned for the near future.

SAN FRANCISCO, CAL.—The filing of incorporation papers by two light and power companies having similar names and designed to do business in adjacent territory has given rise to rumors of a merger of interests. The Coast Counties Company is incorporated with a capital of $1,000,000, divided into 40,000 shares of a par value of $100, half being preferred and half common stock. The incorporators are: Henry Mallock, Oakland; William R. Bosley, Geo. H. Susman, S. W. Pryer, S. oVlmer and K. L. Dazey, San Francisco and J. E. Daub of Oakland. The Coast Valleys Company is incorporated for $5,000,000. The shares have a par value of $100 and are divided as follows: 20,000 preferred and 30,000 common. The incorporators are: H. A. Thornton, Berkeley; John F. Forbes, Alameda; A. R. Franklin, Sausalito; F. W. Geiger and G. V. Matthews of San Francisco. The principal place of business of both companies is given as San Francisco. Rumors has it that the two companies have been organized by interests allied with the Sierra and San Francisco Power Company, the former to take over plants in Santa Cruz and San Benito Counties controlled by John Martin and associates the latter to operate properites owned by W. P. Hammon and others embracing the Monterey County Gas & Electric Company, the Pacific Grove Railway Company and the Salinas Valley Water Company.

ILLUMINATION.

SANTA ROSA, CAL.—There was but one bid for the franchise applied for by the Great Western Power Company, and that company was granted the franchise.

ANTIOCH, CAL.—Van E. Britton has been granted a franchise to lay, operate and maintain a system for the distribution of gas, gas pipes, conduits, etc., for furnishing the town with light, heat and power.

FLORENCE, ORE.—A franchise will be granted to G. G. Bushman of Sheridan, to install an electric lighting plant and operate the same. Contractors will start the construction soon and have the plant in operation by September.

ALAMEDA, CAL.—The bond election involving $200,000 will be held April 30. The money is to be used in buying a new site and erecting buildings and increasing the capacity of the municipal light plant at a cost of $150,000, and in improving the police and fire department service.

SEATTLE, WASH.—An ordinance reducing the cost to the consumers from 7 to 6 cents per kilowatt hour, up to 60 kw., and 4 cents an hour for all over 60 kw., has been recommended for passage by the city utilities committee. The amendment also reduces the minimum charges for residences from $1 to 50 cents after the first year. If passed by the council the ordinance becomes effective July 1.

SALT LAKE CITY, UTAH.—The controlling interest to the Utah Gas & Coke Company has passed into the hands of Kelsey, Brewer & Company, of Grand Rapids, Mich. The price paid by the Michigan company is not announced, but it is reasonable to assume that it will run close to $750,000. The interest acquired by Kelsey, Brewer & Company is the stock owned, up to Monday, by the Farwell Trust Company of Chicago, and its associates. Kelsey, Brewer & Company specialize in the operation of gas and electric properties, and now control plants in Indiana, Michigan and Illinois and recently acquired the Boise, Idaho, gas company

SAN FRANCISCO, CAL.—The Universal Electric & Gas Company, of which Claus A. and Rudolph Spreckels are the leading factors, has closed a deal for a 100-vara lot fronting 275 feet on Brannan street by 275 on First. It is announced that on this newly acquired property the Universal Electric & Gas Company will erect a plant large enough to furnish illumination to this and other cities about the bay. The concern was incorporated on the 27th of last month, the capital stock being fixed at $5,000,000. J. H. Sanford and Frank Harrold of this city and P. S. Scales of San Mateo are identified with the Spreckels as stockholders in the Universal.

SAN FRANCISCO, CAL.—John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has sent to the Board of Supervisors a statement of the items included in the total of $16,324,785.65, which was given as the amount of the company's assets in a former statement. The figures as to assets now furnished are as follows: Electric plant, $14,206,779.99; steam sales plant, $170,849.46; deposited in Bank of California on special rate case accounts, $123,-512.68; material and supplies, $241,427.54; advance taxes, $22,091.23; investments other than bonds, $5647.54; bond investments, $133,118.65; bills and accounts receivable, $1,417,-418.08; suspense salaries, $940.48; total $16,324,785.65. A statement of the business of the Metropolitan Light & Power Company last year, signed by Leopold Michels as president, was also submitted by Mr. Britton. It shows that the Metropolitan's revenue from gas during the year amounted to $364,-092.83 and the costs to $238,282.97, leaving a gross profit of $125,809.86. The revenue from other sources amounted to $43,014.34, including $39,661.15 on account of the excess gas rates which were held by court order and $1456.49 for meter rentals. Deducting $76,881.72 for bond interest, the net profit for the year was $91,942.48. The book value of the plant is placed at $6,853,807.79; capital stock, $5,000,000; bonds outstanding, $1,625,000; floating debt, $21,777.80.

TRANSPORTATION.

WENATCHEE, WASH.—The City Council has granted an electric railway franchise to Wenatchee Valley Railway & Power Company, of which E. J. Felt is the head. It is said eastern people are backing him to the extent of $1,000,000.

OAKLAND, CAL.—Application was made of the Board of Supervisors for a 50-year franchise for a street car road on Eunice street, north of the Berkeley line, by the Oakland Traction Company. The application was referred to the roads committee for 30 days.

SUTTER CITY, CAL.—Construction work has begun this week by the Northern Electric Company at both ends of its Marysville-Colusa branch. George Summy, a Sutter rancher, put 100 head of stock at work at Terra Buena near Yuba City. Others were put to work at Meridian. The road will go one-half mile south of Sutter, as the $24,000 bonus asked by the company to change the route could not be raised.

LEWISTON, IDAHO.—Contracts for the construction of the electric line out of Nez Perce will be let within 30 days by the Pacific Light & Power Company, according to reliable information received in Lewiston. That the A. A. Welch interests are now securing bonds for their properties in Oregon to finance the North Idaho deal is definitely known. The contracts when all let, will involve close to $10,000,000.

SAN RAFAEL, CAL.—The stockholders of the San Francisco Northern Electric Railroad have decided to take no action for the present on their proposed road via Santa Rosa, Petaluma, San Rafael and San Quentin, outside of making a few preliminary surveys. The company was started by eight well-known business men who subscribed $5000 each. Of this amount they paid $25,000 for the San Quentin terminal. Later the San Francisco Northern was incorporated and the transfer made.

SALT LAKE CITY, UTAH.—Application for a franchise for operation of cars of an electric interurban railroad on certain streets of the city has been filed by Judge William H. King, representing a number of local and Eastern capitalists. This road is projected from Salt Lake City south through Salt Lake County, Utah County, and eventually into the coal regions of Emery County. Application for a similar franchise was made some time ago by a company headed by former Senator A. J. Evans and is slated to come up for consideration at an early date. One of the principal purposes of the road will be to carry the coal from Carbon and Emery Counties, where it is produced so abundantly, to Utah and Salt Lake Counties, where it can be distributed for consumption, as well as for shipment beyond the State. Preliminary surveys have been made and the company represented by Judge King says it has the necessary capital to push the road to an early completion. Formal application for the franchise will be filed within the next ten days.

PORTLAND, ORE.—The sale of the Mount Hood Railway properties to the Portland Railway, Light & Power Company, negotiations for which have been in progress for more than a year, was completed March 23. The purchasing company will assume the contract of the Mount Hood people to complete the reservoir site at the head of the Sandy River, and the rail lines of the two companies will be connected and operated as one system. The Mount Hood property consists of a small distribution system in North Portland and in the Peninsula district and a railway 20.3 miles long running up the Sandy River to a reservoir site. The railroad is not yet electrified, but is operated by the aid of steam. There also is a power house capable, it is said, of producing 15,000 kilowatts, upon the banks of the Bull Run, where the water can be obtained from a reservoir partially constructed. There is a tunnel 4000 feet long and a flume two or more miles long. It is this property which the Portland Railway, Light & Power Company has taken over.

TELEPHONE AND TELEGRAPH.

OTHELLO, WASH.—The business men here have organized a telephone company. A. B. Crawford heads the board of trustees.

WINCHESTER, IDAHO.—Both the Nez Perce Co-operative Telephone Company and the Pacific Telephone & Telegraph Company have secured franchises to operate in this city.

EUREKA, CAL.—With the coming summer the Northwestern Pacific Railway Company will commence the building of a copper wire telephone system for train dispatching on the northern division of the line to extend from Eureka to Shively.

MEDFORD, ORE.—The Federal Telegraph Company has purchased an 11 acre tract of land one-half mile east of the water tank in Central Point and will establish a large wireless telegraph station there. It is the intention of the company to erect two 300-foot towers and put in all necessary appliances to make this one of the largest and most complete stations on the Pacific Coast.

ONTARIO, CAL.—The two telephone companies have transferred their holdings to the Ontario-Upland Telephone & Telegraph Company, which has been organized here. The directors elected are H. M. Robinson, W. A. Freemire, R. B. Campbell, J. R. Pollock and R. Grant White. Campbell was chosen president; Freemire, vice-president; Robinson, secretary and treasurer and White, manager. The object of the company is to consolidate the two present systems and raise the service to the highest possible efficiency. The present rates are not to be raised, and connections between the two systems will be made in the immediate future. The two offices will be combined as soon as the switchboard can be properly arranged. Both systems will be used for long-distance calls.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII — SAN FRANCISCO, APRIL 6, 1912 — NUMBER 14

TURBINE AND BOILER EFFICIENCY TESTS IN OAKLAND[1]

BY ROBERT SIBLEY AND R. F. CHEVALIER.

Some years ago the Pacific Gas & Electric Company installed at their Station "C" in Oakland, California, a 9000 kw. vertical Curtis turbine. During the past months the generating output of this station has been largely augmented by the installation of a 12,000 kw. similar unit. In order to house the new equipment, the building formerly occupied, has been extended considerably to the south and now has a substantial concrete front.

The steam consumption of this new turbine in lb. per kw. hour, with a steam pressure of 175 lb. (gauge) at the throttle, was guaranteed not to be more than 15.2 at 7500 kw. output, 14.5 at 10,000 and 14.6 at 12,000, with not more than 1½ lb. absolute back pressure in exhaust chamber of turbine, dry steam, 100 deg. F. superheat.

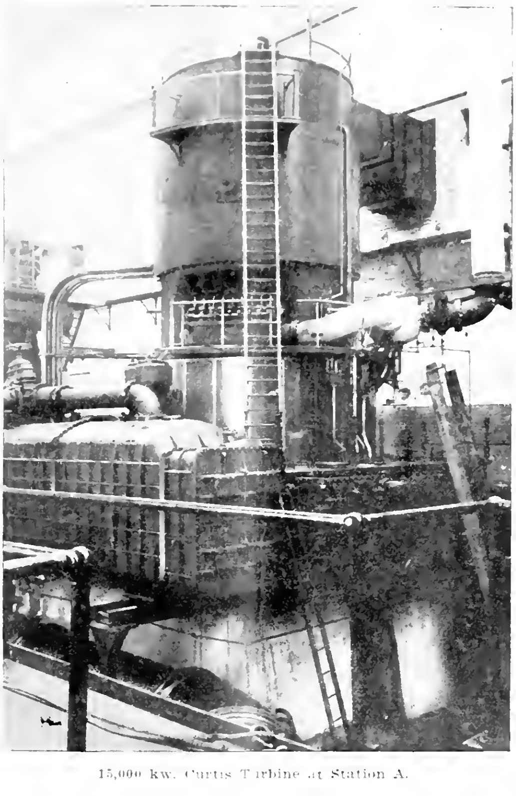
The following correction factors were agreed upon to apply if exact contract conditions could not be maintained while steam consumption tests were made.

1 in. absolute back pressure in condenser is equivalent to 1 lb. in water rate per kw. hour between 2 in. and 1 in. absolute back pressure at loads ranging from 10,000 to 12,000 kw. At loads less than 10,000 kw., 1 in absolute back pressure is equivalent to 1.2 lb. in water rate per kw. hour, between 2 in. and 1 in. absolute back pressure in condenser.

10 lb. steam pressure equals 1 per cent in water rate per kw hour. It was agreed that the steam pressure under test conditions would not vary more than 5 per cent from 175 lb.

12½ degrees F. was agreed to equal 1 per cent in water rate per kw. hour. It was agreed that under test conditions the superheat would not vary more than 25 per cent from 100 degrees F. It was subsequently agreed under excessive superheat of test to allow 14 degrees F. equal 1 per cent in water rate per kw. hour.

From the results of the test, the data of which is herewith appended, it was found that for a 10,000 kw. load the water consumption was 14.7 lb. per kw. hour and for the 12,000 kw. load it proved to be but 13.87 lb. per kw. hour.



15,000 kw. Curtis Turbine at Station A.

The new turbine unit has the condenser installed in its base and hence in this respect differs from the former 9000 kw. installation at this station. In the condenser, are to be found 5600 tubes each 17 ft. 2 in. long, comprising a journey of over 18 miles for the water in passing through the condenser. 25,000 gallons per minute or 36,000,000 per day constitute the necessary circulating water supply. Oakland, Alameda and Berkeley use only 19,000,000 gallons of water per day, hence it is seen that this turbine alone uses a greater supply than all three cities combined for their municipal use.

The turbine operates at 720 revolutions per minute and generates at 4150 volts, 60 cycle, supplying three-

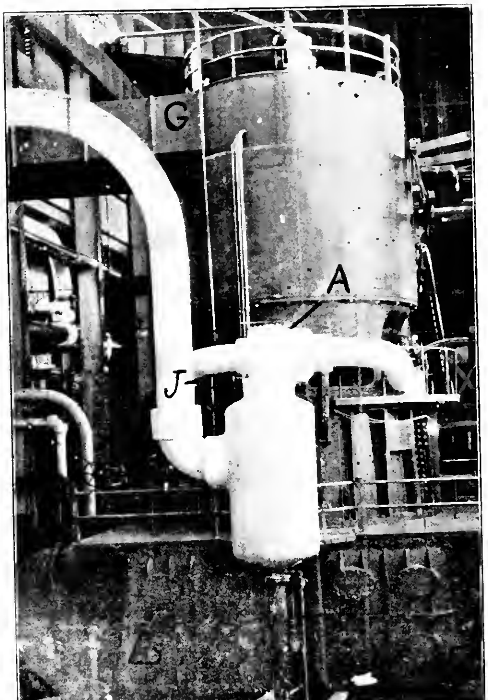
[1]A paper read before the San Francisco Section of A. I. E. E., March 29, 1912.

Turbine Test Data.

		10000 K.W. Load	12000 K.W. Load
CORRECTION FOR STEAM PRESSURE			
Pressure during test	lbs	171.5	166.4
Correction for gauge error, add.	lbs	1.0	1.01
Corrected pressure	lbs	172.5	167.4
Guarantee based on	lbs	175.0	175.0
Test pressure (low)	lbs	2.5	7.6
From contract, 10# pressure equals 1% in water rate.			
Correction pressure factor for steam pressure		0.25%	0.76%
CORRECTION FOR STEAM TEMPERATURE.			
Temperature during test	deg	521.20	538.8
Correction for stem exposure	deg	5.65	5.99
Corrected temperature during test.	deg	526.85	544.79
Absolute pressure during test	lbs	187.20	182.
Temperature at test pressure	deg	376.20	373.90
Superheat during test	deg	150.65	170.89
Guarantee based on superheat of	deg	100.00	100.00
Superheat during test (high)	deg	50.65	70.89
14 deg. Fah. Superheat equals 1% in water rate.			
Correction factor for temperature	%	3.62%	5.05%
CORRECTION FOR VACUUM			
Average vacuum during test corrected	in.	28.229	28.02
Guarantee based on	in.	28.500	28.50
Vacuum during test (low)	in.	0.271	0.48
From contract 1" absolute back pressure equals 1# in water rate.			
Correction factor for vacuum	lbs	0.271	0.48
SUMMARY			
Total lbs. of water weighed	lbs	559623.	673910.
Scale #1 - 3/4 lb. high 88 lbs.			
Scale #2 - 1/2 lb. high 56 lbs	lbs	144.	144.
Total water	lbs	559479.	673766.
Total K.W. output	lbs	40320.	48925.
Uncorrected water rate (Gross)	lbs	13.876	13.771
Correction for steam pressure. sub. 0.25% * 0.76%	lbs	0.034	0.104
Correction for steam temperature + 5.06% • 3.62%	lbs	.502	0.698
Correction for vacuum, subtract 0.49	lbs	0.271	0.490
Total corrections, add	lbs	.197	[illegible]
Corrected water rate	lbs	14.073	13.873

phase alternating current. Its base dimensions are 17 ft. 6 in. long and 17 ft. wide and has a height of 33 ft. 4 in. The outer edge of the disk travels at the rate of 400 ft. per second or 6545 miles a day.

In cooling the generating windings, 50,000 cu. ft. of fresh air per minute are required and this is sup-



15,000 k.v.a. Curtis Turbine at Station C.

Boiler Test Data.

1. Date of test		Feb.24,12	Feb.26, 12
2. Duration of test		8 hours	5 hours
3. Type of burner		Internal Mixer	
4. Make of burner		Staple-Pfeiffer	Owens
6. Number of burners used		4	4
5. Water-heating surface	sq.ft.	7254.	7254.
7. Superheating surface	sq.ft.	116.	116.
AVERAGE PRESSURE			
8. Barometer	inches	30.20	30.31
9. Steam pressure by gauge (saturated)	lbs.sq.in.	185.3	194.1
10. Oil pressure at burner	lbs.sq.in.	50.4	123.
11. Force of draft in breeching	ins. water	.55	.62
12. Force of draft before damper	ins. water	.34	.49
13. Force of draft in furnace (near supt)	ins. water	.06	.05
14. Force of draft in ash pit	ins. water	.06	.08
AVERAGE TEMPERATURES			
15. External air	degrees F.	57°	54°
16. Fire room	degrees F.	64°	77°
17. Air entering ash pit	degrees F.	64°	77°
18. Escaping gases from boiler	degrees F.	370°	440°
19. Oil at burner	degrees F.	96°	90°
20. Feed water entering boiler	degrees F.	169.1°	174.1°
21. Superheated steam	degrees F.	527°	536.9°
22. Saturated steam before superheater due to pressure	degrees F.	381.9°	386.6°
23. Degrees of superheat	degrees F.	145.1°	161.3°
FUEL			
24. Kind Cal.Crude-Reed Oil Co. fuel oil)		crude	fuel oil
25. Gravity of oil at 60° F.	specific	.9705	.9705
26. Gravity of oil at 60° F.	deg.Beaume	14.32	14.23
27. Percentage of water in the oil	per cent	.7 of 1%	.5 of 1%
28. Calorific value of dry oil per lb.	B.t.u.	18758.	18752.
29. Weight of oil as fired	lbs	15084.	15115.
30. Weight of oil consumed corrected for moisture	lbs	14978.	15039.
FUEL: AVERAGE PER HOUR			
31. Oil consumed per hour as fired	lbs	1885.5	3023.
32. Oil consumed per hour corrected for moisture	lbs	1872.	3008.
33. Oil per hour corrected for moisture per cu. ft. of furnace volume	lbs	1.756	2.82
34. Oil per hour corrected for moisture per sq.ft. of heating surface	lbs	.258	.415
WATER			
35. Total weight of water fed to boiler	lbs	205277.	199077.
36. Factor of evaporation		1.178	1.177
37. Equivalent evaporation from & at 212°	lbs	241816.	234318.
WATER: AVERAGE PER HOUR			
38. Water evaporated per hour	lbs	25659.	39815.
39. Equivalent evaporation from & at 212°	lbs	30227.	46863.
40. Equivalent evaporation from & at 212° per sq. ft. of water heating surface	lbs	4.17	6.46
HORSE POWER			
41. Horse power developed A.S.M.E. rating	H.P.	876.	1378.
42. Builders' rated horse power	H.P.	773.	773.
43. Percentage of builders' rating developed	%	113.3%	175.7%
ECONOMIC RESULTS			
44. Water apparently evaporated under actual conditions per pound of oil as fired	lbs	13.61	13.17
45. Equivalent evaporation from & at 212° per pound of oil as fired	lbs	16.03	15.5
46. Equivalent evaporation from & at 212° per pound of oil corrected for moisture	lbs	16.14	15.58
EFFICIENCY			
47. Efficiency of the boiler	%	83.53	80.82
ANALYSIS OF THE DRY GASES BY VOLUME			
48. Sample taken where gases leave 1st & enter 2nd pass			
49. Carbon dioxide (CO_2)	%	14.3	14.9

plied through the steel duct shown above the turbine to the left. The rotating part of the turbine weighs 75 tons, its total weight being 320 tons.

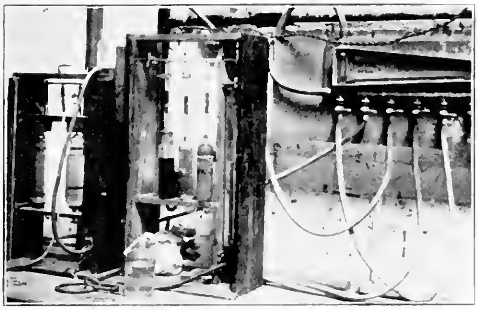
Boilers.

The turbine is supplied with steam from four 773 h.p. water tube boilers of the Parker type. Each boiler contains 366 four-inch tubes 20 ft. long. The total heating surface per boiler is 7734 sq. ft. with a grate surface of 48 sq. ft.

The boilers were guaranteed, under conditions of sale, to evaporate 15½ lb. of water per lb. of oil. The oil was to be on a calorific basis of 18,500 B.t.u. per lb., and the evaporation of the boiler water from and at 212° F. The boilers are also guaranteed to stand an overload of 60 per cent on their builder's rating without sending forth chimney gases at a temperature of above 600° F. All of these limits were well met. Under test the boilers evaporated 13.61 lb. of water per lb. of oil. The oil analyzed 18,752 B.t.u. per lb. Hence 16.14 lb. of water was evaporated per lb. of oil on the basis of 18,500 B.t.u. per lb. The efficiency, hence, exceeded 83½ per cent. As to overload conditions, 75 per cent overload was maintained for five hours

with an efficiency above 80 per cent and with chimney gases below 15 per cent CO_2.

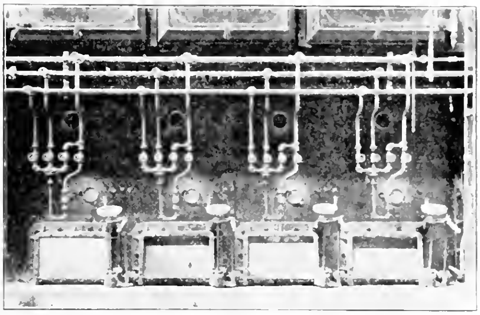
The design of the air draft admission gates to the boiler furnace is unique and of high efficiency. As shown in the illustration, wheels attached to worm gears operate the draft openings and thus the draft can be regulated to the minutest detail. In the performance of the efficiency test the careful manipulation of these gates aided greatly in securing the best conditions of operation. The closing of the damper doors tends to bring the air towards the tip of the burner.



Orsat Apparatus and Draft Gauges.

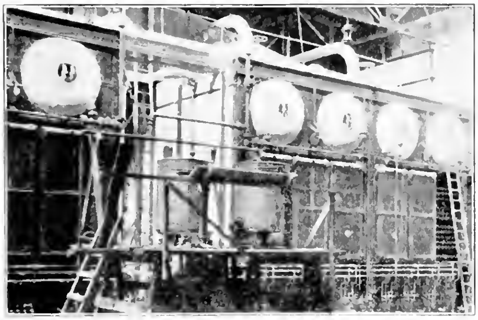
The condenser is of the Worthington two-stage type and contains 25,000 sq. ft. of cooling surface. It is situated in the base of the turbine and the circulating water enters toward the center and divides outwardly returning by two separate mains. The feed water heater is of the Wheeler vertical closed type and has 2000 sq. ft. of heating surface.

The accumulator, manufactured by R. D. Wood & Company has a 11½ in. by 14 ft. horizontal stroke. It is of the accumulator tank ballast type and is capable of developing 1150 lb. per sq. in. working pressure and actually delivers 950 lb. per sq. in. to the step bearings. This accumulator is held in reserve for the two turbines above referred to. The oil tank filter is of the Turner type and is 12 ft. 3 in. by 4 ft. with a height of 5 ft. The condenser discharges into a steel hot well tank 10 x 6 x 5 ft. The dry vacuum pump is of the rotative type and manufactured by Laidlaw-Dunn-Gordon Company. The size of the cylinders are 14 x 39 x 30 in.



Oil Burners and Draft System.

A Byron-Jackson circulating pump with a capacity of 40,000 gallons per minute performs the function of supplying the condenser with water. The circulating pump engine has a cylinder of 16 x 27 x 35 in. and is manufactured by the American Engine Company. The exciter used for the new turbine is of 125 kw. capacity and of the Curtis vertical turbo-exciter type. The Alberger Pump Company supplied the four-stage turbine pump for the feed water. The hot well pumps used to lift the water from the condenser into the hot well is of the Worthington turbine driven two-stage type and is motor driven. Two Dean pumps 12x27/8x12 in. are used to supply the high pressure for the step bearings, while two Dean pumps 5½ x 3¾ x 5 in. supply the pressure for the guide bearings. Two Snow pumps, 5¼ x 4¾ x 5 in., are used to secure the oil return. The new steel stacks are 125 ft. high with a diameter of 10 ft.



Water Weighing Apparatus and Parker Boilers.

The complete new equipment is now in full and successful operation and stands as a sentinel ready to safe-guard continuity of service at all times in case of a temporary shut down in the mountains of any of the hydroelectric plants of the Pacific Gas & Electric Company or in event of excessive peak load conditions developing at any time on the distributing system of the company.

TELEPHONE TROUBLES IN TACOMA.

The entire Pacific Coast seems rent with agitations at present over the absorption of the independent lines by the older and stronger corporation, owned by the Bell telephone interests. San Francisco had its innings last week when its citizens expressed themselves as overwhelmingly in favor of the taking over under municipal ownership of the independent telephone lines.

Now comes Tacoma with its troubles. Here we find last week the franchise of the Home Telephone Company giving it the right to maintain and operate a telephone system in the City of Tacoma was revoked by the City Council in legislative session.

This franchise is now held by the Sunset Telephone & Telegraph Company, which purchased the Home Telephone system at a Federal receiver's sale several months ago for $550,000.

The franchise of the Sunset Company will expire in 1915, while the franchise of the Home Company would have run until 1930.

WESTERN LAWS OF ELECTRICITY AND WATER

RIPARIAN RIGHTS IN THE WESTERN STATES

BY A. E. CHANDLER.

According to the common law doctrine of riparian rights in the law of waters, each owner along a stream was entitled to have the waters thereof flow in the natural channel, unpolluted in quality and undiminished in quantity. A strict interpretation of the doctrine would therefore forbid any use of the waters of the stream whatsoever. It was early modified in England so that two uses are recognized—ordinary or natural, including the use for domestic and stock purposes, and extraordinary or artificial, including the use for irrigation along the banks and also for mechanical purposes. For "ordinary" uses the upper riparian owner is allowed to take the entire stream if necessary; but for "extraordinary" uses he is entitled to water only when such use will not interfere with a like use by other riparian owners—that is, he must share the stream with others along its banks.

As shown in the previous paper, a different doctrine—that of appropriation—grew up during the early occupancy by the miners of the public domain in the Western States. It was also shown that the early California cases establishing the new doctrine were between parties not holding title to any land along the streams; and that the Supreme Court of Nevada in Van Sickle v. Haines (7 Nev. 249) and the Federal Circuit Court for Nevada in Union Mill & Mining Co. v. Ferris (2 Saw. 176) in 1872 held that in cases where title to riparian land had passed from the Government, the new doctrine must give way to the older and long recognized (in England and the Eastern States) doctrine of riparian rights.

The basis of the argument for the rule laid down in the two Nevada cases was a statutory provision making the common law of England the rule of decision in all the Nevada courts. It is important to note the following words of Chief Justice Lewis (in Van Sickle v. Haines) regarding the two doctrines, as they show an erroneous view of the doctrine of appropriation which, unfortunately, has been shared by the courts in many Western States:

"It (the common law) is a rule which gives the greatest right to the greatest number, authorizing each to make a reasonable use of it, providing he does no injury to the others equally entitled to it with himself; whilst the rule of prior appropriation here advocated would authorize the first person who might choose to make use of or divert a stream, to use or even waste the whole to the utter ruin of others who might wish it."

In marked contrast to the attitude of the Nevada courts in the early cases is that of the Colorado courts. In Coffin v. Left Hand Ditch Co., 6 Colo. 443, decided in 1882, the issue between riparian owners and appropriators was before the court for the first time. Coffin and others were riparian owners along the St. Vrain River, who, in the dry season of 1879, interfered with the ditch of the Ditch Company, which diverted the St. Vrain waters to another watershed. The company being a prior appropriator, Coffin relied upon his riparian right. The opinion is full of strong expressions showing the need of appropriation in an arid section, but a few concluding sentences only are given here:

"We conclude, then, that the common-law doctrine giving the riparian owner a right to the flow of water in its natural channel upon and over his lands, even though he makes no beneficial use thereof, is inapplicable to Colorado. Imperative necessity, unknown to the countries which gave it birth, compels the recognition of another doctrine in conflict therewith. And we hold that, in the absence of express statutes to the contrary, the first appropriator of water from a natural stream for a beneficial purpose has, with the qualifications contained in the constitution, a prior right thereto to the extent of such appropriation."

In the late seventies the case of Jones v. Adams, (19 Nev. 78), arose out of conflict over the waters of Sierra Creek, which, like Daggett Creek of the Van Sickle case, is a small Sierra creek in the west side of Carson Valley in Nevada. It was decided by the Supreme Court of Nevada in 1885 and the Van Sickle case was overruled on the ground that the doctrines of the common law were inapplicable "to the wants and necessities of the people, whether engaged in mining, agricultural or other pursuits." The doctrine of riparian rights was thus excluded from the law of waters in Nevada and has so remained.

The year following the decision in Jones v. Adams, the Supreme Court of California decided the celebrated case of Lux v. Haggin (69 Cal. 255). The extreme length of the opinion (two hundred pages—probably the longest in the California reports) is sufficient evidence of its importance and the interest in the issue involved. Lux and others sought to stop Haggin from diverting the waters of Kern River which would naturally flow down Buena Vista Slough, to which their lands were riparian. As in the Van Sickle case, the court had a wrong impression of appropriation and stated " . . . It does not require a prophetic vision to anticipate that the adoption of the rule, so called, of 'appropriation' would result in a monopoly of all the waters of the state by comparatively few individuals. . . ."

The riparian doctrine as modified in Lux v. Haggin is commonly called the California rule. Its principles, so often quoted, are best given in the words of the court:

"By the common law the right of the riparian proprietor to the flow of the stream is inseparably annexed to the soil, and passes with it, not as an easement or appurtenance, but as part and parcel of it. Use does not create the right, and disuse cannot destroy or suspend it. The right in each extends to the natural and usual flow of all the water, unless where the quantity has been diminished as a consequence of the reasonable application of it by other riparian owners for purposes hereafter to be mentioned.

"By our law the riparian proprietors are entitled to a reasonable use of the waters of the stream for the purpose of irrigation. What is such reasonable use is a question of fact, and depends upon the circumstances appearing in each particular case. . . ."

Lux v. Haggin was decided by a divided court of four to three. It has not only fastened the rule of riparian rights upon California, seemingly for all time, but have been the main reliance of the other western states following the California rule. The following

extract from the dissenting opinion of Justice Ross shows how decided was the difference of opinion among the Justices:

"The common-law doctrine of riparian rights being wholly inconsistent with and antagonistic to that of appropriation, it necessarily follows that when the federal and state governments assented to, recognized, and confirmed, with respect to the waters upon the public lands, the doctrine of appropriation, they in effect declared that that of riparian rights did not apply. The doctrine of appropriation thus established was not a temporary thing, to exist only until some one should obtain a certificate or patent for forty acres or some other subdivision of the public land bordering on the river or other stream of water. It was, as has been said, born of the necessities of the country and its people, was the growth of years, permanent in its character, and fixed the *status* of water rights with respect to public lands."

The California rule has been adopted in California, Kansas, Montana, Nebraska, North Dakota, Oklahoma, Oregon, South Dakota, Texas and Washington. Parts of each of the states named are so humid that irrigation is not only not necessary, but there is a demand for drainage. In the remainder of the irrigation states—Arizona, Colorado, Idaho, Nevada, New Mexico, Utah and Wyoming—the doctrine of riparian rights has been abrogated and the so-called Colorado rule followed; that is, the doctrine of appropriation exclusively. It may assist one to remember the above classification by noting that the semi-arid or "border" states (that is, bordering the irrigation zone) follow the Caliornia rule, and that the strictly arid or "interior" states (that is, well within the irrigation zone) follow the Colorado rule.

One often hears the remark that there is no real conflict between the doctrines in California to-day, and it many times comes from a supposedly reliable source. Even the Supreme Court of Nevada in a recent case, Twaddle v. Winters (29 Nev. 88) decided in 1906, in speaking of the passing of the doctrine of riparian rights, quoted with approval the testimony of a California Congressman in the case of Kansas v. Colorado, in which he said "that there had been a departure from the principles laid down in Lux v. Haggin, because at that time the value of water was not realized; that the decision had been practically reversed by the same court on subsequent occasions, and that the doctrine of prior appropriation and the application of water to a beneficial use is in effect in force now in that state."

The above statement is entirely misleading, as the California Supreme Court has not only not departed from its position in Lux v. Haggin, but has within the past few years handed down opinions which almost nullify the doctrine of appropriation under certain physical conditions.

While the Nevada Supreme Court was writing its opinion in Twaddle v. Winters, the case of Miller & Lux v. Madera Canal Co., (155 Cal. 59) was before the California Supreme Court. It was finally decided in January, 1909. Miller & Lux as riparian owner along the lower Fresno River sought to enjoin the Madera Canal Company from diverting the flood waters thereof for storage in reservoirs. The Fresno River drains only the lower mountain area and is therefore dry early in the summer. The canal company is the owner of a system of ditches for the lands in the vicinity of Madera and intended to make use of certain natural depressions as reservoirs so that the flood waters of May and early June might be stored for use later in the season. The river banks through the Miller & Lux property are so low that the floods annually overflow them and deposit "on such lands large quantities of fertilizing and enriching materials, increasing their productiveness and enhancing their value."

The canal company argued that it intended to divert and store only the flood waters which could not be considered part of the natural flow to which riparian owners were entitled, and that the use, if such it could be called, of the flood waters by Miller & Lux was too wasteful and unreasonable to be tolerated. The Court refused to accept this argument in the following language:

"What the riparian proprietor is entitled to as against non-riparian takers is the ordinary and usual flow of the stream. There is no good reason for saying that the greatly increased flow following the annually recurring fall of rain and melting of snow in the region about the head of the stream is any less usual or ordinary than the much diminished flow which comes after the rains and the melted snows have run off."

"The doctrine that a riparian owner is limited to a reasonable use of the water applies only as between different riparian proprietors. As against an appropriator who seeks to divert water to non-riparian lands, the riparian owner is entitled to restrain any diversion which will deprive him of the customary flow of water which is or may be beneficial to his land. He is not limted by any measure of reasonableness."

A case even more bewildering to appropriators, if possible, was that of Miller v. Bay Cities Water Company, decided one year later—February, 1910. Miller was the owner of a small orchard in the Santa Clara Valley and had for years irrigated it by pumping from a well. The water company intended to construct a dam to bed rock across the "lower gorge" of the Coyote River and thus impound the flood waters of the stream for diversion to San Francisco or other bay cities. Below the lower gorge the river flows through Santa Clara Valley to San Francisco Bay, so that no lower storage is possible. Miller claimed that the dam would prevent the underground waters from reaching the water bearing stratum tapped by his well and sought an injunction.

The Supreme Court sustained the finding of the lower court that the water bearing stratum below Miller's land has its "intake" in the vast bed of gravel in the lower gorge and is supplied by the surface and subsurface waters of the Coyote River flowing through said gorge. It accordingly affirmed the decree perpetually enjoining the water company "from arresting or obstructing at or above the lower gorge (except for the reasonable use thereof on the lands of said corporation in the exercise of its riparian rights) any of the water of the Coyote River which, excepting for said arresting or diverting, would flow on the surface of the bed of said river through said gorge, or would flow or percolate through said gorge underneath the surface thereof."

In a later article it will be shown that the owners of land overlying a water bearing stratum are treated in California as riparian owners, so the Supreme Court held that the water company was properly restrained from diverting to non-riparian lands the water which would flow through the stratum tapped by Miller's

well. The water company insisted "that if the plaintiff has a right to enjoin the diversion of the waters of the stream which would otherwise percolate to and supply the artesian stratum underlying his land, the court was not warranted in enjoining the appellants from diverting the flood waters of the Coyote River, which it was claimed were wasted and lost in the bay of San Francisco."

Regarding this argument the Supreme Court said:

"All these waters are necessary, of themselves or by their force, to supply underground waters, which they, even now, fail to do to the full capacity of the underlying strata, to which full capacity the plaintiff and others interested in them are entitled. . . . We are not prepared to say that, even in their flow after passing the gravels in which the intake to these artesian strata lie, they serve no other useful purpose, but certainly these storm waters do not become waste until they have flowed over these gravel beds and are on their way to the bay. It is only there that it may be said that they can perform no further useful service, the only place where they first become waste waters, and where, without apparently invading the rights of anyone they may be diverted. No reasonable objection could be made to the diversion of the waters there because they are then, for all practical purposes, waste waters."

The above ruling seems to establish so wasteful a policy that Justice Shaw wrote a concurring opinion and clearly presented the dire need of storage of our flood waters, showing the accomplishment of the triple purpose of lessening damage by overflow, affording irrigation water during the dry season and, through return waters from increased irrigation, bettering navigation during the low water period. He held, however, that the conditions in the Santa Clara Valley are not paralleled elsewhere in the State, except it may be in the San Fernando valley, and call for the rule laid down; that the floods when waste occurs are infrequent and such waste small and practically indeterminable; that the storage at chance intervals of such small quantities, subject to heavy evaporation losses, would be of little value; and that granting permission to store such waste while conferring no substantial benefit upon the water company would lessen the value of the valley property overlying the water bearing stratum.

The two cases above discussed are of particular interest as the era of reservoir building in the states recognizing the riparian doctrine is just beginning. The point to be remembered is that each case deals with such conditions that the court believes actual damage would be done if storage was allowed. This is emphasized in the recent case of Miller & Lux v. Fresno Flume Co. (158 Cal. 626), decided November 22, 1910, wherein the plaintiff sought to have enjoined the maintenance of defendant's dam and its alleged interference with the natural flow of Stevenson Creek, a tributary of the San Joaquin River.

Plaintiffs quote many California cases "as establishing the proposition that the riparian owner is entitled to the unobstructed flow of a stream at all times, including flood waters . . . . and that, without regard to damage, it is the right of every riparian proprietor to have the water come to his land through its natural channel, undiminished in quantity and unimpaired in quality, save to the extent that results from reasonable use of the water by other riparian owners upon the stream."

In answer to this argument the court says:

"But the cases do not support the position which appellants take. Even if at common law or under the civil law it was a part of the usufructuary right of the riparian owner to have the water flow by for no purpose other than to afford him pleasure in its prospect, such is not the rule of decision in this state. . . .

It will be found, therefore, that the decisions of this state not only do not deny the right to the use of storm and flood waters, but encourage the impounding and distribution of those waters wherever it may be done without substantial damage to the existing rights of owners."

The court continues:

"In Miller v. Bay Cities Water Co., 157 Cal. 256 (107 Pac. 115), the principle is clearly recognized and declared that an appropriator of water may divert for use to any point beyond the watershed any portion of the waters of the stream which serves no useful purpose either to the riparian owners, or in supplying the underground stratum, or such waters as are in excess of the quantity necessary for such purposes";

And later in quoting from Miller & Lux v. Madera Canal Company, states,

"That our cases 'decide that an injunction restraining the diversion of storm or flood waters will not be granted at the instance of a riparian owner, when it appears that he will not be injured in any way by such diversion.'"

It is finally concluded that if the doctrine laid down in the earlier cases confers such rights upon riparian owners as claimed by plaintiffs, then such earlier cases may be considered modified by the later decisions. It is shown in the closing part of this opinion that both parties are really riparian owners so that the relative rights of appropriators and riparian owners did not actually arise in the case. The language used has therefore the force of a dictum only, but as it was accepted by an undivided court it will undoubtedly hold in such cases.

The conclusion that must be drawn from the above is that lower riparian owners may not only enjoin the diversion of the natural flow but may also enjoin the storage of even the flood waters if such storage will result in damage, either present or prospective. It is therefore of vital interest to know the limits of riparian lands and the general limitations which other states have placed upon the riparian doctrine. These subjects will be considered in the next article.

PROGRESS OF WATER RIGHT ADJUSTMENT IN OREGON.

In view of the interesting articles by A. E. Chandler now appearing in these columns on the subject of water rights, the following conclusions on water right laws of the State of Oregon, by John H. Lewis, State Engineer of Oregon, are given as they appeared in the Pacific Builder and Engineer. As Mr. Chandler was one of those who were instrumental in bringing about the new water right conditions in Oregon, added interest attaches.

The doctrine of beneficial use was taken as the basis for the Oregon system of titles. The recent law of 1909 rests primarily upon the declaration that "all waters within the State from all sources of water supply belong to the public," and that the State through its police power is charged with the administration of this property in such a way as to promote the peace and safety of its citizens.

To administer this property a board was created composed of the State Engineer and the superintendent of each of the two divisions into which the State was divided. While certain specific duties are assigned to the different members of this board, the responsibility of determining old rights, the granting of new rights, and the protection of all rights when determined requires action of these officers sitting as a board.

The systematic determination and recording of existing water rights is one of the important duties of this board. The task is comparable to the preparation of the Domesday Book by William the Conqueror, which was the first attempt in England to systematize land titles. This water record is the foundation for police regulations necessary for the protection of the individual user. It is the basis for computing the surplus water in a stream as a guide for new investments. It will also serve as a basis for the distribution of water, by the water masters, for the protection of new as well as of old rights.

The water code has now been in successful operation for three years, during which time no serious defects have developed. It appears to be giving general satisfaction to all concerned.

This law would never have been enacted but for the support of the commercial and other interests who are concerned only in the development of the State as a whole. It will take from five to ten years yet, and more liberal appropriations to complete the determination of all old rights, and to collect full information as to the State's water supply.

These same interests should continue their support and vigilance to see that this law is maintained upon the statute books for a sufficient length of time to give it a fair trial. To change the system at this or any other time is to undo all that has gone before. If at each session of the legislature some new system for recording deeds and mortgages was provided, it would lead to such confusion of titles to to destroy land values. Water right values in fully three-fourths of the State are of more importance than land values. It is, therefore, all the more important that the present system of water titles, which is based upon twenty years experience in Wyoming, should be given a thorough trial before any radical change is made.

So important is this matter that some State organization interested in the highest development of our water resources should undertake the preparation of a constitutional amendment which will more firmly establish the present system, and submit the same to a vote of the people. The adoption of such amendment would go far in restoring confidence. Until this is done the time of each legislature will be so fully consumed in defeating legislation proposed by enemies of the present system that much needed new legislation cannot be secured.

To the average settler the question of water titles and water measurements appear most complicated. It is no wonder that a few wildcat enterprises have caused such a lack of confidence among prospective purchasers of irrigated lands, as to make difficult the colonization of lands under legitimate enterprises. This lack of confidence has spread to the eastern bond markets, thus making it difficult to finance new enterprises.

With its model water law and a fair beginning in the collection of water data, Oregon is in the front rank of Western States for a speedy recovery from present unsatisfactory conditions. Now that the experimental stage is over, the people should not hesitate to make adequate appropriations for stream surveys, and for the determination of existing rights, so that our surplus water supply may be known. The public should fully appreciate the fact that future development will depend upon the collection of these data, and will be in proportion to the confidence of capital and the water users in the State's administrative system. Under the present law wildcat enterprises can in the future be prevented from imposing on the public if water supply data is available and sufficient funds provided for investigations by the State's administrative officers prior to the issuance of permits. When water maps and records are available and can be interpreted as definitely as land maps, confidence in all classes will be restored as to water projects, and not before.

WESTERN UNION PENSION PLAN.

The Pacific Coast executives of the Western Union Telegraph Company have received advices of the inauguration of a pension plan for the benefit of the 30,000 employees connected with that corporation throughout the United States. Announcement was made by President Theodore N. Vail as follows:

The plan in detail is as follows: Upon retirement, after 20 years of service and up to and including the twenty-fifth year of such service, the employee receives 1 per cent of the average salary for the ten years immediately preceding retirement multiplied by the total years of service. After 25 years of service and up to and including the thirty-fifth year of such service, 1½ per cent additional for each additional year. After 35 years of service and up to and including the fortieth year of such service, 2 per cent additional for each additional year. After 40 years, 50 per cent.

The minimum pension allowance to be $25 a month, except when otherwise directed. No pension under this plan will exceed $100 per month.

N. E. L. A. TOURS TO SEATTLE.

In connection with the 35th annual convention of the National Electric Light Association at Seattle, Wash., June 10-14, 1912, the transportation committee has arranged several special tours de luxe for Eastern delegates. Special trains will leave New York City and Boston on May 26, visiting en route Grand Canyon of Arizona, Southern California, San Francisco and Seattle, arriving June 9 and returning on June 14 by way of Portland, Yellowstone Park, Salt Lake City and Denver. Other special trains will leave New York and Chicago on June 4, by way of the Canadian Rockies, while specials will also be run from Chicago on June 6 and St. Louis on June 5. Beautiful booklets and other literature are being sent to all members so as to arrange for accommodations in advance. Special reduced fares have been given by the railroads.

TRADE RELATIONS IN THE ELECTRICAL INDUSTRY.

BY PHILIP S. DODD.

The question of trade relations between the central station, the jobber, the contractor and the manufacturer has been for many years much debated. While some relation along co-operative lines has been recognized as a vital necessity to the growth of the electrical industry, the point for debate has always been as to just what this co-operation could be and just what lines it should follow.

It is recognized that the central stations must, to a certain extent, take the initiative because of the fact that it is their current which will be used for the operation of all current consuming devices sold.

There are so many points to be considered and local conditions vary so greatly, that the question of co-operation along any line, must naturally be a question to be discussed locally, rather than as a national proposition. Either locally or nationally the question can logically, only be arrived at satisfactorily from one viewpoint,—"The greatest good to the greatest number"—and by the "greatest number" means not only the manufacturers, the central station and other distributors of energy and devices, but the public as a whole—the ultimate consumer of electrical energy and electrical products.

Admitting that the use of electrical energy through some form of current consuming devices, confers a benefit on the vast majority of the individuals who go to make up our population—the question is, how best to increase the uses of electricity and educate the masses to a fuller knowledge of the benefit that lies at their hands.

Considering the question from the viewpoint of industrial economies, it would seem that this education could be best handled through co-operative effort on the part of the various interests who are endeavoring to increase the sale of current consuming devices or electrical energy and as it clear that co-operation is only possible where each have equal opportunity for profit in proportion to investment or effort expended, it would appear necessary that the first step toward any practical move for development would be harmonization of the various allied, but sometimes warring interests.

Agreements must be reached and adhered to, as to the definite field of operation of each and arrangements made which will give to each a fair return, and an equal opportunity. Once this is accomplished the means for development of the market are many.

To the initiated, electricity is a simple servant, easy to handle and control, and always ready for work at a pull of the switch or a pressure of the button, but it must be remembered that to the greater majority of the public, it has been a thing of fear—a stupendous mystery and that increase in its use must come through education—education along the lines of safety, economy, healthfulness, readiness and sureness of service and the like.

Education is more vital to the increased use of electricity than to the marketing of any other commodity which is in general use by the public today. Efforts toward that education are being made in many directions and in many different ways. Through publicity work on the part of the various local organizations, such as the Jovial Luncheon Clubs, Lunch-Club branches of the National Electric Light Association company sections, Development Leagues, etc., and the effort that is being made by them in every progressive city, where it has not already been started, to publish co-operatively an electrical page in the newspapers. By their co-operation with boards of trade, chambers of commerce, to advertise and assist in the development of the city itself by the use of electric signs, improved street lighting, etc., etc., and in several cases where it has been successfully demonstrated that it is possible to arrange with school boards for the introducing of electrical courses in the schools and colleges.

The commercial section of the National Electric Light Association is doing a number of practical things for the development of the industry through the preparation and distribution by some of its committees of publications of educational value covering the wiring and lighting of homes, the lighting of factories, work shops, etc., the lighting of streets, sign lighting, etc., and by the dissemination among its members for use in their work with the public, of information pertaining to commercial practical selling methods, data relative to current consuming devices, power data, etc., etc. Its future plans include a cumulative index of the above together with a complete catalogue of current consuming devices and properly indexed digests or abstracts of articles of commercial interest appearing in the current technical papers.

All this work being co-operative not only on the part of the operating companies but by them with the manufacturers, the jobbers and contractors, is effecting the entire industry and is gradually but surely bringing about more harmonious relations among the different interests and settling day by day the question of trade relations which until only recently has stunted the growth of the business.

We are all learning,—the central station that real development comes only by the use of intelligent effort in educating the public and by active co-operation with the jobbers, contractors and manufacturers, and the jobber, contractor, and manufacturer that it is not only desirable but necessary that they co-operate with and secure the full co-operation of the central station.

The Commercial Section, the Jobbers' and Contractors' Association, the Jovian Order as a whole and through its local organizations and the various other local organizations are all working co-operatively among themselves and in many instances with each other towards practical concatenated effort for the development and betterment of the business as a whole, and while individual publicity is logical and valuable and will without doubt always be continued, the tendency is toward mutual effort for mutual good, not only along publicity lines, but in many other channels. The time is not far distant when this working together of the various interests will be settling quietly and naturally the differences which may appear difficult in the extreme to us all today.

SOLUTIONS OF THERMOTWISTERS.

The Indicator Card—Sixteenth Lecture.

BY J. F. POLLARD.

1. By reading up cross references on the indicator outline a series of rules of procedure in taking cards from the indicator.

Rule 1.—Procure an indicating device suitable to the type of engine which is to be tested. The Thompson indicator is one of the oldest and probably the best known. The Crosby indicator is well adapted to engines running at high speed (up to 400 r.p.m.) Other types of this class, such as the Taber and Star Brass "Navy Pattern" differ from the Crosby only in the method of producing straight line parallel motion of the pencil. For engines running more than 400 r.p.m. some form of optical indicator should be used. The subsequent rules will deal only with the Crosby indicator which is a common and a good type.

Rule 2.—Before using an indicator carefully clean all of the working parts, especially the piston. Next select a spring of such a scale that with the highest pressure to be recorded the height of card will not exceed about $1\frac{3}{4}$ in. Attach the spring in its proper position and after smearing a little cylinder oil in a thin coat on the working surface of the piston, replace the parts. Occasionally oil the moving parts of the pencil mechanism with watchmaker's or porpoise oil.

Rule 3.—Adjust the screw on the handle provided for moving the pencil so that when the latter is well sharpened a very fine line will be drawn.

Rule 4—Adjust the length of the indicator cord so that the drum will be neither too loose nor too tight; that is to say will not strike either of the stops when the engine is operating. The cord used should be selected with care since it must be of such quality as not to be stretched appreciably by the forces to which it is subjected.

Rule 5.—The atmospheric line should always be taken preferably after the diagram has been made. It is drawn after the indicator cock is closed. Always keep cock closed and cord detached from cross-head except when a card is to be taken. Do not allow the drum to snap back against the stop when the cord is unhooked.

Rule 6.—As soon as a card has been made it should be removed and examined. If any inexplicable irregularities in the lines or unaccountable differences in lengths or areas of different cards are noted a strenuous effort should be made to remedy the faults. (Enumeration of most general sources of error and suggestions for their remedy as given in problem 2 below.)

Rule 7.—After a test, the indicator should be removed immediately from the engine, protecting the hands with waste or thick gloves to prevent burns. All the parts, especially those in the cylinder, should be thoroughly cleaned and then put together again without the spring, which should be put away with the other springs in a box provided for the indicator. An indicator should never be handled by taking hold of the drum, as usually it is fastened to the indicator by only a loose slip joint and this comes off easily.

2. Make a list of all errors which frequently arise in the taking of indicator cards and devise cures or methods to avoid the same.

(1) Moyer states "About one-half the troubles with indicators in operation arise from loose springs, although probably not so frequently with the Thompson indicators as with some other types." The remedy for this is to take care to screw up the spring firmly against both the cap and the piston.

(2) Stretching of the indicator cord will cause the production of inaccurate cards. This can only be remedied by putting on a new cord of material that will not stretch under the tension to which it is to be subjected.

(3) Another frequent source of error is grit on the piston. This must be removed by taking out the piston cleaning it and lubricating it again with cylinder oil.

(4) Before replacing the piston and connecting parts in the cylinder it should be seen to that all the parts are connected firmly and without lost motion as this is another source of error in cards.

(5) Sometimes and particularly is this true in the case of gas engines, overheating of the piston will cause excessive friction which might be remedied by any of the common cylinder cooling devices, such as a coil carrying circulating water, a water jacket or in this case by simply arranging a small stream of water to flow over the outside of the cylinder.

(6) One of the causes of errors in results obtained with indicators not so readily detected is due to the pencil motion not being parallel to the direction of motion of the piston in the indicator. A simple test for this is to draw an atmospheric line on a card placed on the drum. The card should be at least as wide as the height of the drum. Then after taking out the spring raise the pencil to the full height of the card by pressing lightly on the piston. This operation may be repeated several times at different points along the length of the card. If the lines drawn are exactly perpendicular to the atmospheric lines there is no error in the pencil mechanism.

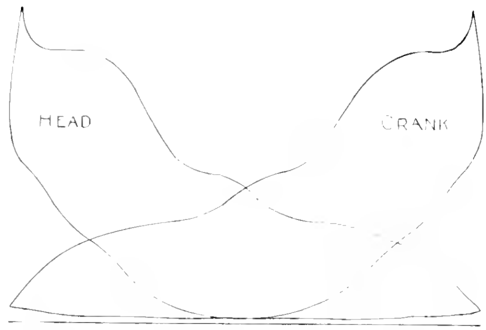
(7) Inexperienced testers often make the mistake of putting the spring and piston into place by merely slipping on the sleeve without screwing down the cap. Then, as a result, when the steam pressure is put on the indicator the piston, spring and pencil mechanism are thrown off with a great deal of force, and some of these expensive parts are sometimes completely demolished.

References: "Applied Thermodynamics for Engineers," by W. D. Ennis, and "Power Plant Testing," by J. A. Moyer.

COMPUTATION OF IRREGULAR AREAS—EIGHTEENTH LECTURE.

BY E. H. ZEIFFUCHS

1. Given the indicator cards of crank and head ends as shown below taken from a steam engine, compute the area by all six methods, thus satisfying yourself as to accuracy of each.

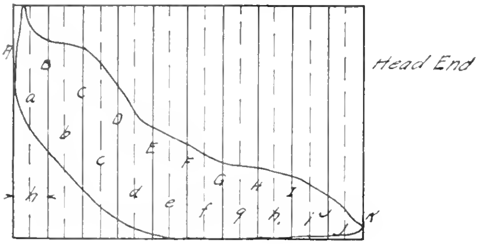


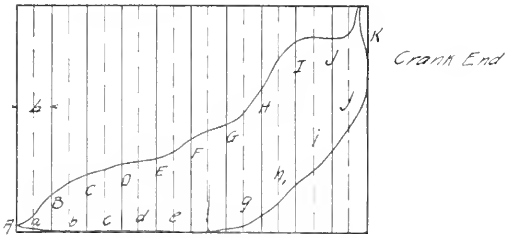
1st Method. By adding up the squares included in the diagrams.

Head End — 1735 sq. mm.
Crank End — 1650 sq. mm.
1 sq. mm. = 0.00155 sq. in.
Head End = 1735 × 0.00155 = 2.69 sq in.
Crank End = 1700 × 0.00155 = 2.62 sq. in.

2d Method: Trapezoidal Method:

$$\text{Area} = h\left(\frac{A}{2} + B + C + D + E + F + G + H + I + J + \frac{K}{2}\right)$$





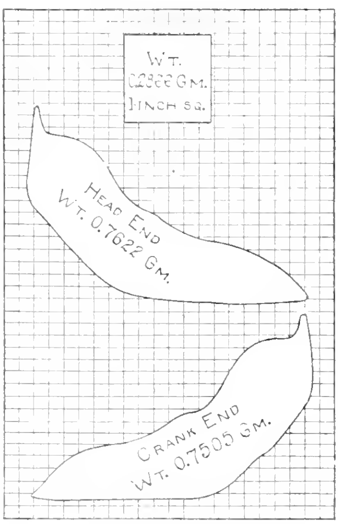
Method of Subdividing Card.

Head End

$$= 8.3\left(\frac{24}{2} + 27.2 + 33 + 30.2 + 25 + 22 + 18.2 + 16 + 14 + \frac{20}{2}\right)$$

$$= 8.3 \times 207.6 = 1687 \text{ sq. mm.}$$

$$1687 \times 0.00155 = \mathbf{2.67} \text{ sq. in.}$$



Areas by Weights

Crank End

$$= 8.3\left(\frac{0}{2} + 9.5 + 14 + 16.5 + 17.5 + 23 + 25 + 30 + 33 + 26.5 + \frac{20}{2}\right)$$

$$= 8.3 \times 205.0 \times 0.00155 = \mathbf{2.64} \text{ sq. in.}$$

Third Method: Length of Lines Proportional to Areas:

Area $= \Sigma(a+b+c+d+e+f+g+h+i+j)$

Head End

$$= 8.3\ (23.75 + 30.5 + 33 + 27.4 + 23 + 20 + 17.2 + 15 + 12 + 6)$$

$$= 8.3 \times 207.85 \times 0.00155 = \mathbf{2.67} \text{ sq. in.}$$

Crank End

$$= 8.3\ (5 + 12.5 + 15.6 + 16.8 + 19.3 + 25 + 26 + 33 + 31.5 + 18)$$

$$= 8.3 \times 207.2 \times 0.00155 = \mathbf{2.67} \text{ sq. in.}$$

4th Method: By Weighing:

Head End, Area $= \frac{0.7622}{0.2866} = \mathbf{2.66}$ sq. in.

Crank End, Area $= \frac{0.7505}{0.2866} = \mathbf{2.62}$ sq. in.

Fifth Method: By Simpson's Rule:

$$\text{Area} = \frac{h}{3}(A+K) + 4(B+D+F+G+H+J) + 2(C+E+G+I)$$

Head End: Area under upper curve

$$= \frac{8.3}{3}(55+2.5) + 4(47.5+35.5+22+16.5+11)$$

$$+ 2(45.2+26.5+18.2+14)$$

$$= 2.765 \times 794.5 \times 0.00155 = 3.41 \text{ sq. in.}$$

Area under lower curve

$$= \frac{8.3}{3}(33+2.5) + 4(20+5+0.5+0.5+.75) + 2\ (12+1.75+0+0.5)$$

$$= 171.0 \times 2.765 \times 0.00155 = 0.734 \text{ sq. in.}$$

3.41
.73

2.68 sq. in. H.E.

Crank End: Area under upper curve:

$$= \frac{8.3}{3}(2+55) + 4\ (10+16.2+25.5+34.5+46.8)$$

$$+ 2\ (14+17.5+26+45.5)$$

$$= 2.765 \times 783 \times 0.00155 = 3.36 \text{ sq. in.}$$

Area under lower curve

$$= \frac{8.3}{3}(2+55) + 4\ (0+0+0+4.5+20) + 2\ (0+0+0.5+12.2)$$

$$= 2.765 \times 180.4 \times 0.00155 = 0.7725$$

3.36
.77

2.59 sq. in. C.E.

6th Method: By Planimeter:

Head End: Reading of wheel at start.... 0.000
1st trial " " " " finish... 2.73
2d " " " " " " ... 5.41

Mean Reading, 2.70

Area = 2.70 sq. in. H.E.

Crank End: Reading of wheel at start.... 0.000
1st trial " " " " finish... 2.65
2d " " " " " " ... 5.30

Mean Reading, 2.65.

Area = **2.65** sq. in. C.E.

Summary. **Areas.**

	H.E.	C.E
Method Adding Squares.........	2.69 sq. in.	2.62 sq. in.
" Trapezoidal	2.67 " "	2.64 " "
" Lines Prop. Areas......	2.67 " "	2.67 " "
" By Weighing	2.66 " "	2.62 " "
" Simpson's	2.68 " "	2.59 " "
" Planimeter	2.70 " "	2.65 " "
	16.07	15.79
	Head End.	Crank End.
Average Area of Six Methods...	**2.68** sq. in.	**2.64** sq. in.

THE STEEL TOWER TRANSMISSION LINE OF THE PORTLAND RAIWAY, LIGHT & POWER COMPANY.[1]

BY E. D. SEARING.

Early in 1911, the Portland Railway, Light & Power Company decided to construct a steel tower transmission line to deliver the power from the River Mill plant to Lincoln substation, in the city of Portland.

The River Mill plant was well under construction at that time and has, since, been placed in operation. It is a water power generating station on the Clackamas River, about three-quarters of a mile from the town of Estacada and near the way-station of River Mill, both on the Oregon Water Power & Railway line, an interurban electric railway owned by the company. The capacity of the plant is designed for an ultimate of 20,000 k.v.a. maximum. At present there are installed three 3667 k.v.a. alternators, generating at 11,000 volts, 60-cycles and stepping up through individual three-phase transformers, star connected, to 57,000 volts. The current at this latter voltage is delivered to the line through the usual busses, switches, etc.

Lincoln substation is the Portland terminal of the line and is situated near the foot of East Lincoln street. This point is in the Oregon Water Power & Railway freight yards and only a short distance from the main tracks. The substation contains apparatus, similar to that at the generating plant, for receiving the current at the line voltage and stepping it down to 11,000 volts, at which voltage it is distributed to the various parts of the city, through overhead, underground and submarine cables.

At the entrance of the line at both River Mill and Lincoln substation, aluminum electrolytic arresters are installed for protection to the apparatus against line disturbances. The lines are carried into the buildings through wall entrance bushings at the generating station and through roof entrance bushings at the substation.

The foregoing defines, in a general manner, the occasion for constructing the line, the voltage and the power to be transmitted, and the locations of the stations between which it extends.

From the River Mill plant, the course of the line runs for about half a mile, mostly across company property, to the right of way of the Oregon Water Power & Railway. From this point, it follows the right of way to Barton Station. Here, the survey leaves the right of way and crosses what is termed Barton, or Boring Hill, in a direct line to Sycamore station, again on the right of way. The line continues from this point, on the right of way, or company property, to Lincoln substation. As thus outlined the total length is 27.6 miles. With the exception of the portion proposed from Barton to Sycamore, the line is now constructed as originally contemplated. The survey over the hill extends through private property the entire distance and, on account of difficulties encountered in securing right of way, this portion is carried, temporarily, below another circuit on one of the wooden pole lines already constructed on the public highway. By deviating from the railway right of way, the line is thus made shorter by about five miles and avoids a number of long spans, stream crossings, sharp curves, and two villages.

The line is carried on steel supports for its entire length, except as noted previously. The standard support is a tower constructed entirely of galvanized materials, consisting of angles, channels, etc., bolted together. This structure is of a self-supporting, or inflexible, type and is designed to carry two power circuits of three conductors each, one telephone circuit of two wires and one ground wire. The circuits are in vertical planes on each side of the tower and 11 ft. apart. The conductors of each circuit are 6 ft. apart, suspended from three horizontal crossarms. The telephone wires will be in a horizontal plane 8 ft. below the lowest conductor, passing through the middle of the tower. The ground wire is 4 ft. above the upper crossarm and on the center line of the structure.

The tower is built up of four leg-angles, forming a base 12 ft. square at the ground and tapering to 3 ft. square at the lowest crossarm. From the lowest to the upper crossarm, the tower is of uniform cross section. Above this point, the angles converge to approximately 5 in. square to receive the cap casting for clamping the ground wire. The sizes of the leg angles vary from $3\frac{1}{2}$ in. x $3\frac{1}{2}$ in x $\frac{1}{4}$ in. at the ground to $2\frac{1}{2}$ in. x $2\frac{1}{2}$ in. x $\frac{1}{4}$ in. at the top. The main structure thus formed is braced and trussed in all directions by angles ranging from $1\frac{1}{2}$ in. x $1\frac{1}{2}$ in.x $\frac{1}{8}$ in. to $2\frac{1}{2}$ in x $2\frac{1}{2}$ in. x $\frac{1}{8}$ in. The crossarms each consist of two 4 in. channels with webs vertical, bent in such a manner that their ends meet and bolted to the sides of the tower at right angles to the line. The insulator support consists of a flat plate with a $1\frac{1}{4}$ in. hole for attaching the insulator, bolted between the ends of the crossarm channels. The lowest crossarm is 48 ft. from the ground, making the standard tower 64 ft. in height to ground wire clamp.

Where higher towers than the standard were necessary and for steep slopes, 10 ft., 20 ft. and hillside extensions were used. The 10 and 20 ft. extensions are constructed similar to the standard towers; they attach to the leg-angles at the bottom, have the same taper and make the total height of the tower 74 ft. or 84 ft. depending upon which is used. The hillside extension differs only in that it has two longer legs to be placed on the downhill side.

To facilitate climbing the towers, steps are provided on one corner, extending from a point 8 ft. above the ground to the lowest crossarm; they consist of 4 in. lengths of $\frac{1}{2}$ in. gas pipe bolted to the angles by a bolt running lengthwise through the pipe. These steps alternate up the two sides of one of the corner angles, 18 in. apart. The towers are anchored by ground stubs consisting of an angle set into the ground and bolted to each leg; this angle having a shoe 2 ft. square made up of channels bolted together.

The standard towers each average 4100 lb. in weight and were fabricated in New York City. Before proceeding with the whole order, the manufacturer constructed a sample tower and subjected it to stated tests which were witnessed by a representative of the com-

[1]Paper presented before Portland Section, A. I. E. E., March 19, 1912.

pany. The test loads specified were: a pull of 12,500 lb. applied at the intersection of the middle crossarm and the center line of the tower; a pull of 4000 lb. applied at the ends of any two crossarms (aggregate pull, 8,000 lb.); a pull of 6,000 lb. applied at the end of any crossarm; all these in the horizontal and in the direction of the line; and a vertical load of 1500 lb. applied at the end of any cross arm. The tower was accepted on the basis of its withstanding these tests without distortion. The values for the loading were derived from an assumed maximum condition of 25 degrees F. below 0, one-half inch of ice all around the conductors, an indicated wind velocity of 70 miles per hour and with any two conductors broken.

The towers were received entirely "knocked down," the smaller members being wired together and the bolts boxed. Bundles and boxes contained parts for individual towers only. The larger members, bundles and boxes were marked so as to identify them in making up complete towers. The parts were distributed for assembling piece by piece, at the site of each tower. In all cases where space and conditions permitted, the towers were assembled on the ground and erected by a separate gang. They were arranged in assembling in a position so that when raised into the vertical, the legs would strike the holes for the ground stubs, the holes being left open until after the towers were erected.

The erecting was carried out by attaching a footboard, or "kicking plank," to the legs of the side resting on the ground, the plank being staked to keep it from kicking or sliding. A single gin pole was used for erecting, set in a hole about a foot in depth and sufficient distance in front of the tower to clear it when vertical. The pole was attached to the tower by a short hitch with it inclined back on the tower. The tackle rigged on the pole was anchored well ahead and back and side lines were attached to the tower while it was being raised; a two-horse team was used for pulling; when the tower reached nearly a vertical, the ground stubs standing free in the holes were attached to the two legs forward. The tower was then swung further until these legs took the weight off the "kicking plank." This was then detached, the other two stubs were bolted on, and the lines slacked off, allowing the tower to stand on all four legs. A separate crew finished the work of aligning the towers and backfilling the holes. Along the greater portion of the line completed, the towers were erected between existing high tension wooden pole lines. This, in connection with the cuts and fills for the road bed made it necessary to erect a number of towers, piece by piece, from the ground up. This operation proved too expensive to permit of erection in this manner where space was available for assembling with the towers lying on the ground.

The standard spacing of the towers on tangent is 500 ft. This spacing was varied from 150 ft. on curves to as high as 560 ft. in one instance where it was impossible to secure a location on the right of way otherwise. Care was used to locate towers near each public highway crossing in order to secure the maximum clearance below the lowest conductors.

The tracks of the Oregon Water Power & Railway follow regularly dedicated streets through the original townsite of Sellwood. The streets being public property and values placed on private property, made it necessary to employ special construction through this length; steel poles set just inside the curb line were used to meet this condition, they were manufactured in Portland and are ungalvanized; the main members consist of four main angles, latticed together with smaller ones; the tops are about 1 ft. square; the bases are 2½ ft. square at the ground and extend 8 ft. into the ground in a pedestal of concrete. The height and design of crossarms and ground wire clamps and vertical spacing of conductors and ground wire are identical with the towers. The horizontal spacing of conductors is 7 ft. instead of 11 ft. in the case of the towers. This lesser spacing between circuits was adopted on account of the normal spacing of poles being but 200 ft.

Carried at the extreme top of all the structures and held firmly in the clamp provided for that purpose, is a ⅜ in. seven-strand, extra galvanized, Siemens-Martin cable. Besides acting as a target for lightning and a patch, through its connection with the ground for the dissipation of overhead electrical disturbances, this wire serves to transmit to those adjacent and equalize any unusual strain occurring on any individual support. This wire, in addition to its connection to the ground through its contact with the metal of the structure, is also grounded at intervals of a mile through a copper wire soldered to it and carried down and soldered to a galvanized pipe into the ground.

The insulators used throughout are the single-piece unit suspension type. Each unit has a galvanized iron cap with a spherical socket, open on one side, and a short steel pin with a ball end. The cap and pin are both cemented to the single pieces of porcelain and the socket receives the ball-end of the pin of the next unit in the series. Three units are employed to make up a complete insulator in the suspended or vertical arrangement. Where insulators are used in a strain or horizontal position, four units are employed. No special strain towers or special strain insulators were used; however, to prevent creeping of the line, due to unusual stresses set up by temperature, winds and difference in elevation of supports, the conductors were dead ended at towers on an average of every two miles. The chain of units is suspended from the crossarm connection by a hook which also fits the socket in the insulator cap. The conductor is attached to the insulator by a clamp which grips the same securely.

Two styles of clamps were used, suspension and strain. The suspension clamp is designed to hold the wire in the hanging position and the strain clamp in the dead end or horizontal position. The clamps have clevises attached to sockets identical with those of the insulator caps. The insulator is easily assembled by slipping the ball and socket parts together. Cotter keys prevent the parts from disconnecting after they are installed.

The insulator, built up of units connected in this manner, makes a flexible combination, free to adjust itself to all conditions without internal torsional or bending stresses. The insulator units were shipped crated in sets of nine each, this being sufficient for three insulators as ordinarily used throughout the con-

struction. Each unit was tested before shipping at from 95,000 to 100,000 volts for dry flash-over, and at 4,000 lb. pull for mechanical strength. After the mechanical test, the insulators were again put through the potential test to check against any defects which may not have appeared in the first test or were developed by the mechanical stresses. These tests were made by a representative of the company, employed especially for this work.

As stated previously, the towers are constructed to support two circuits of three conductors each. The line, as at present installed, consists of one circuit, with the exception of the portion from the River Mill plant to the first intersection with the Oregon Water Power & Railway right of way. This length carries two circuits, one continuing to Lincoln substation, the other tieing-in with the pole line to Portland from the Cazadero plant, located further up the Clackamas River.

The conductors are 250,000 c.m. hard drawn, stranded copper and are calculated to transmit the entire output of the River Mill plant with less than a 10 per cent loss. These cables were received on reels carrying about 5500 ft. each. The stringing was performed by setting up the reels on "horses" and reeling off the cable, using a team to pull the cable off the reel and along the line. Hinged-side running blocks were attached to each crossarm on all the towers covered by the length being strung. The insulators were placed in position at the same time. The cables were then pulled up to the crossarms, one at a time, and placed in the running blocks by opening up the hinged side. The end being fast at the last tower strung, the cable was then pulled until the required sag was reached as shown by a table of spans, sags and temperatures furnished the stringing crew. By using the blocks, the cable adjusted itself to a uniform tension throughout the pull and assumed the natural sag for each span, automatically. The cable was then transferred from the blocks to the clamps attached to the insulators. The scheme of using the blocks and stringing, at about a mile to the pull, worked to such perfection that no trouble was experienced by insulators swinging out of plumb in the direction of the line, due to the accumulation of unequal tensions. The telephone circuit will not be installed for some time to follow.

The aggregate of materials required for the line is 310 standard towers, 32 10 foot extensions, 22 20 foot extensions, 17 Hillside extensions and 11 steel poles, total weight, 1,370,000 lb.; number of insulator units, 3750; weight of copper conductors, 350,000 lb.; weight of steel ground wire, 45,000 lb.

Serving a large power customer at Beaverton, is a branch line connecting with the main tower line near The Oaks Amusement Park. A 3-pole disconnecting switch supported on a separate standard tower is installed at his connecion. The branch line spans from the switch tower to a specially constructed steel tower 100 ft. high on the east bank of the Willamette River; thence to another similar tower 85 ft. high on the west bank and thence to wooden pole construction for the balance of its length. The span across the river is 1790 ft. and clears the mean low water level of the river under maximum loaded conditions about 80 ft. When thus loaded, the pull per conductor figures 14,000 lb. or an aggregate of 42,000 lb. at the top of each tower.

The design of transmission tower structures depends first, upon fundamental principles and thereafter, to a large degree upon data observed in connection with the tests on full size samples. The fact that a transmission tower is not expected to be absolutely rigid necessitates that other points be taken into consideration in the design besides theory. The amount of deflection permissable without its being permanent is high, many of the members are small, and, as a result, there is certain to be a reversal of stresses. The only method of determining the proper distribution of materials to resist these stresses is to observe the structure under actual stressed conditions.

The unit costs of this installation are not of value for comparison, on account of some of the more unusual conditions under which it was carried out. One of the most pronounced of these is the proximity to and resulting care necessary on account of existing high tension lines supply exceedingly important service, also, an exceptional number of crossings over lines of this character was necessary; difficulty was met in the character of the soil, a large percentage of the holes encountered sand and gravel, combined with water; others were in cemented gravel-and-boulder hard-pan and required blasting; as already noted, it was necessary to build up a number of towers complete from the ground; after practically all of the holes were dug and about one-third of the towers were still to be erected, unusual rains set in and it was necessary to redig a large number of the holes for these towers; special construction was necessary to avoid the purchase of property held at excessive prices; and the type of construction, on account of the size of conductors and the curves in the alignment, is unusually heavy. As a matter of interest, it may be noted that the total angle in the line amounts to approximately 900 degrees or 2½ complete circles, if angles are all of the same rotation. All of the foregoing conditions are not ordinarily encountered in a single parallel.

The line has been in operation for nearly five months. During this time, it has withstood one of the severest tests, which undoubtedly will ever be applied and this without permanent distress. The "silver thaw" of this year loaded the conductors to at least ten times the ice loads assumed in the calculated maximum conditions. Fortunately the maximum assumed temperature and wind stresses did not accompany this. Such a test would naturally be expected to develop all the defects in a line previously unstressed and this was the case. The trouble experienced was due to the slipping of one of the dead end clamps owing to only a portion of the bolts having been tightened, a result of poor execution in the field. This was sufficient to place the line out of service; however, the line was made inoperative either before or after the above occurred by a complete failure of the temporary connection over Barton Hill. Under normal conditions, the line has not experienced interruption to its operation, other than from the breaking of three units of one insulator and the trouble thus caused by the conductor dropping to the ground. The cause for the insulators breaking has not been determined, though it is thought to have been a bullet.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

The Telephone Situation

Three weeks ago, although aware of a forthcoming special election looking toward the purchase of the independent telephone company by the municipality of San Francisco, although aware that the Public Service Commission would come into lawful supervision one week later, the Pacific Telephone & Telegraph Company absorbed the independent company at a reported price of nearly $10,000,000.

Many looked with favor upon the taking over of the independent company by the Pacific, provided a reasonable price was paid for such of the equipment held by the independent company as might prove useful under a combined system. The heedless manner in which the deal was consummated has had the tendency, however, to dull every human sympathy for either corporation. The citizens of San Francisco have just expressed their sentiment in no uncertain terms by overwhelmingly voting to issue bonds to purchase the independent company in spite of the strenuous efforts on the part of the San Francisco Chamber of Commerce to the contrary.

In the case of the taking over of the independent company by the older and stronger corporation the issue is clear. The independent corporation was well-known to be a doubtful investment from its incipiency. Money was nevertheless played upon this "wheel of fortune" and now that the venture has proved an unquestionable failure, let the speculators in this deal lose their money and not saddle upon the public an eternally interest bearing burden for this blunder.

It is rank injustice to expect the people to pay rentals for the service supplied over and beyond a reasonable return on the useful equipment purchased. Because a corporation has seen fit to effect an arrogant combination a week before the people could legally review the matter by an impartial commission, makes the issue devoid of sentiment or sympathy, and now, if this combination should prove legal, it behooves the commission to sanction the paying by the Pacific Telephone & Telegraph Company of the purchase price and at the same time to allow the corporation the delightful sensation of receiving a rate sufficient to pay a reasonable interest on a reasonable valuation of only the useful equipment, which the former independent company possessed. This is unquestionably far below the reported price involved in the purchase.

For the best interests of all, it is earnestly desired to bring about, in a businesslike manner, an adjustment of the present telephone situation. The ugly agitation now on in Tacoma, a brief of which is to be found on another page of this Journal, is indicative of the kind of public sentiment such overt acts on the part of an arrogant corporation invariably arouses.

Frost Protection by Electrical Methods

We live at the bottom of a great ocean of air. In this vast expanse of aerial sea, the same powerful forces of nature are at work in the formation of eddies, whirl-pools, and other turbulent phenomena are observed in the large oceans of water with which we are so familiar.

The fertile orchard lands of the West, being situated for the most part in mountain valleys, are vis-

ited by cold bodies of air, which slip down from the mountains above into the low valley bottoms. So subtle is nature in bringing about this slippage of cold air along the earth surface, that seldom do we find a freezing temperature at a point 15 to 20 feet above the orchard. Hence, considering a still night, that portion occupied by the tree and immediately surrounding it should be the only portion considered in the ideal heating of the orchard. In a word, the heating of 50,000 pounds of air per acre should suffice. To actually raise this amount of air five degrees in temperature requires only 50,000 x .24 x 5 or 60,000 B.t.u.

Although the present methods are effective in saving the orchard from a killing frost, it is interesting to note the enormous waste heat energies that take place. P. J. O'Gara, meteorological observer at Medford, Oregon, finds from careful tests that 750 B.t.u. are required per tree each minute to actually raise the temperature of the surrounding air five degrees. Assuming 70 trees to the acre, instead of 60,000 B.t.u. being necessary as a whole, we find that every hour are required 3,150,000 B.t.u. Since it is necessary to keep the protective oil fires in operation for several hours, it is easy to see to what enormous totals the B.t.u. consumption may reach. Such inefficiency is almost unbelievable, and yet even at this wasteful figure orchard heating is far within the range of economy in results produced, the saving of thousands of dollars in crops.

Since there is such a wide margin in economy to be accomplished by invention, it is not beyond human conception to believe that an electrical process may be devised in which the heat is carefully and scientifically applied at vulnerable points in the orchard, or a grill effect in the orchard produced, thereby causing the heated air currents to remain earth-bound instead of being carried away skyward. In fact, Professor Alexander G. McAdie of the U. S. Weather Service at San Francisco has definitely shown that a grill effect in an orchard can be produced by laying long strips of paper down the orchard rows, thus preventing heat radiation. If these coverings of paper are placed in the afternoon and removed later in the evening, it is found that an interflow of heat takes place between the air surrounding the strips of ground which did and those which did not have the covering.

A kilowatt hour of electrical energy consumed in orchard heating would evolve 3414 B.t.u. of heat per hour. The margin in economy is so great and the reward both for the inventor and for enormous power consumption contracts so sure and substantial, it is safe to say that another decade will not pass before electrical processes of some sort will be in general use.

As soon as the energetic power plant managers of the Coast appreciate fully the fact that one orchard in California spent over $4700 for successful frost protection last season, the immense application here offered will dawn upon them, and it is safe to say that the smile of happy realization—that smile from ear to ear which invariably appears when dividends and new business heave into view—will lead them to a thoughtful and careful investigation of the electric frost protection problem.

Engineering Ethics

In the last issue of the Journal, editorial comment was made upon the recently adopted code of ethics of the Pacific Coast Association of Consulting Engineers. The agitation looking toward a heightening of the ethical principle now in vogue in the employing of expert engineering witnesses in court trials is worthy of the staunchest support from all those having the interests of justice at heart. To illustrate the present procedure, we shall cite a prominent issue now at law in the Northwest.

Let us take as an illustration the usual procedure in the securing of expert witnesses in the case of damage suits. The Chicago, Milwaukee & St. Paul Railroad during the past few years, at an enormous expense, purchased a right-of-way through the Northwestern States suitable for its Pacific Coast extension. Of necessity, the line passes through many narrow valleys, fertile and prosperous. Natural water channels were changed in construction of the roadbed, but throughout the entire work the highest water levels known to the oldest residents were carefully studied, and proper allowance made in design. A neighboring railroad, the Northern Pacific, paralleling the proposed construction for scores of miles, had been in successful operation for twenty-five years. The records of this old and tried pioneer road were carefully reviewed and the best engineering talent available was utilized in checking up the new work, especially in matters of channel changes. In the spring of 1908, the road was finally completed. A reasonable amount of snow had fallen, and no unusual weather conditions could be foretold. However, in the latter part of May and early in June of that year, an unprecedented rainfall was experienced. Every high water mark known to the oldest inhabitant was submerged. Bridges and roadbed, with their expensive equipment, were all swept away in the narrow canyons of western Montana, causing hundreds of thousands of dollars in damage not alone to the railroad but also to farmers and dwellers along the line. The result was that the railroad found itself not only confronted with having to rebuild its road for many miles, but embarrassed with damage suits totaling almost an equal of expenditure.

In the heated legal battle that at once ensued, the country was scoured for engineering experts who were largely drawn from the territory through which the damage occurred. Today, though almost four years have now elapsed since the flood of 1908, the legal fight still continues. The individual cases are called from time to time, and the experts appear as witnesses for their respective sides, paid and retained by individual parties in interest.

Surely the employment by the court of thoroughly qualified engineers, having the sanction and approval of both parties to an issue, would not only put the consulting engineering profession above idle and hurtful criticism in the rendering of expert opinion, but would at the same time heighten immeasurably the accomplishment of justice, which, after all, is the fundamental excuse of existence for the courts themselves.

PERSONALS.

Ray Chapman has succeeded J. W. White as sales engineer with the Fort Wayne Electric Works at San Francisco.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast department, has returned to San Francisco from Portland.

Fred S. Myrtle, head of the publicity department of the Pacific Gas & Electric Company, has returned from an inspection tour of the system.

R. H. Ballard, the secretary and assistant general manager of the Southern California Edison Company of Los Angeles is at San Francisco.

F. A. Richards, manager of the car department of Pierson, Roeding & Company, has returned to San Francisco after an extensive tour of the Pacific Northwest.

C. M. Clark, chairman of the board of directors of the Portland Railway, Light and Power Company, has returned to Philadelphia from an extended visit to Portland.

J. W. White has resigned as sales engineer with the Fort Wayne Electric Works at San Francisco to become vice-president and chief engineer of the Vix Engineering Company to become effective May 1.

W. S. Coleman now holds the positon in the San Francisco contract department of the Pacific Gas & Electric Company from which F. E. Cronise recently resigned in order to enter the office of N. W. Halsey & Co.

Wynn Meredith and R. S. Buck, who are the Pacific Coast members of the firm of Sanderson & Porter of New York, have returned to their San Francisco office after an extensive tour of Southern California and adjacent territory.

P. M. Hunt, of Hunt, Mirk & Co., is pushing the installation of the Tulare County Power Co.'s new steam-turbine electric power plant at Tulare. It is expected that current will be supplied to the new transmission line within the next two weeks.

R. B. Elder, district manager for several eastern electrical manufacturing companies, left during the past week for a month's tour of the factories, including those of the Ideal Electric Manufacturing Company, at Mansfield, Ohio, and the Moloney Electric Company at St. Louis.

P. M. Downing, engineer of operation and maintenance—hydraulic section—and A. L. Trowbridge, field engineer for the Pacific Gas & Electric Company, spent the past week out on the De Sabla system investigating the situation with a view to future betterments in the way of impounding dams, etc.

H. T. Cory, a consulting engineer of San Francisco, formerly of the Imperial Valley reclamation project, has left for Savannah, Ga., under urgent telegraphic call from the Flood Commission of Georgia in an attempt to solve the recent heavy flood problem along the Savannah River drainage.

A. W. Bullard and Walter S. Crandell were elected directors of the Great Western Power Company at the annual meeting this week, the latter representing the interests of the Edwin Hawley estate. Mortimer Fleishhacker was elected president and A. W. Bullard vice-president and general manager.

J. R. Wilson, sales manager of the Crocker-Wheeler Company of Ampere, N. J., has arrived at San Francisco with Mrs. Wilson on a tour of the Pacific Coast. He will make his headquarters for a few days with John S. Baker, the company's district manager, at 400-402 First National Bank Building.

Ralph L. Phelps, Pacific Coast manager for the Safety Insulated Wire and Cable Company, has returned to San Francisco from the San Joaquin Valley, where the San Joaquin Light and Power Company and associated companies were made agents for Safety Ruby Core Wire, which they have adopted and will handle exclusively.

D. C. Tuttle, formerly with the Stone & Webster Engineering Corporation of Boston, and more recently of the engineering department of the Spring Valley Water Company of San Francisco, has entered the firm of David Bixler & Company of San Francisco, as manager of the machinery department in charge of sales of their construction machinery and equipment in the States of California and Nevada.

W. R. Alberger, formerly vice-president of the traction systems in Oakland and surrounding territory, has been made vice-president and general manager of the new San Francisco-Oakland Terminal Railways. This is a consolidation of the San Francisco, Oakland & San Jose Railway, the East Shore & Suburban Railway and the California Railway. E. A. Heron is president of the executive department. Under the reorganization, J. P. Potter, formerly superintendent of the Oakland Traction and the Key Route, is now assistant to the general manager and head of the transportation department. E. E. Thornton, who was Potter's assistant, is superintendent of transportation. J. Q. Brown, the former chief engineer and purchasing agent, is now assistant to the general manager and chief of the mechanical and electrical department. Stephen F. Kieffer is director of engineering. In the mechanical and electrical department under J. Q. Brown, H. L. Griswold is engineer; H. P. Bell, assistant engineer, and H. Wickson, signal engineer.

ELECTRICAL DEVELOPMENT LEAGUE.

The Electrical Development League of San Francisco will meet at Tait's Cafe on April 9 at 12:15 p.m. Mr. Robt. M. Searle, vice-president and general manager of the Rochester Railway & Light Company, of Rochester, N. Y., will give a strong talk on ways and means of boosting the sale of electric current by means of concerted co-operative effort. All electrical men whether members or not, are invited to attend.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

The contract for Hale Bros.' new building on Market, near Fifth, has been let to McDonald and Kahro, general contractors.

The Fisher Electric Construction Company has been awarded the wiring on the building under construction at Third and Minna streets.

George W. Roberts, of Marysville and W. D. Thomas of Petaluma, are among the electrical contractors who arrived at San Francisco during the past week.

The Butte Engineering & Electric Company has been awarded the wiring on the apartment house on the corner of Franklin, Page and Market streets. The amount of the contract is $4000.

TRADE NOTES.

The Kellogg Switchboard & Supply Company has sold to the Rainier Telephone Company, of Rainier, Oregon, a complete central station equipment. A. L. Clark is president of the company.

The Pelton Water Wheel Company has been awarded a contract for the construction of two 18,600-h.p. Pelton-Francis turbines for the California-Oregon Power Company. This will be the largest turbine wheel ever built on the Pacific Coast. It will be installed at a new plant on the lower Klamath River operating under a head of 125 feet, being direct connected to a 3-phase generator.

A contract for the equipment of the United States cable station at Sitka, Alaska, with an electric power plant, has been awarded by Maj. D. J. Carr, of the United States signal corps, to the Western Electric Company, the lowest in a field of six bidders. The installation of a power plant at the Sitka station has been made necessary by the abandonment and dismantling at that place of the marine barracks, which formerly furnished the power to the Sitka station.

ADDRESS TO JOVIANS BY JUDGE DEBEVOISE.

A place for everything and everything in its place should have been the title of Judge Debevoise's talk to the New York Jovians on March 20th, for it was very much to this point in telling just what the relations of the various branches of the electrical industry, represented by the central station, the manufacturer, jobber and the contractor bore to each other. In his discussion of where the middle-man stood and of his value to the public, he used copper for his basis, and told just what hands or interests it passed through from the mines until it appeared as a useful part of some electrical device in useby the "man in the street," or rather the man or woman of the house.

Judge Debevoise spoke of the present government investigations and the efforts on the part of the government which would in the next few years tend to eliminate from any field the useless middle-man—the middle-man who did not render to the ultimate consumer a real service, or who did not in return for his profit give a service of value to the manufacturer in helping to distribute to the consumer more economically than the manufacturer could distribute himself.

In the electrical industry, he said that the various branches were or should be an unbroken chain, from the manufacturer to the jobber, and thence to the central station and contractor or small dealer, who dealt direct with the public—the first by its sale of current and the second by the sale direct to the public of appliances and various current-consuming devices.

Continuing further, he explained how very logical it appeared that the manufacturers should market their products through the numerous and well-placed jobbing houses, who were not only in a position to carry stocks, so that material could be economically and quickly delivered, but who could keep track of and carry local credits where the manufacturer could not, and who could also assist by bearing a certain proportion of the advertising and all the selling expense for these and many other reasons, the jobber did render an actual and valuable service to the manufacturer and his customer.

The contractor had also his position in the general scheme of things, he said, by distributing apparatus, etc., direct to the public, and by the fact that to the contractor logically belonged this part of the service, and also that of doing the wiring necessary to the sale of these appliances for distribution of the current for their use.

Clashes of these various interests had occurred and were occurring, he said, but through the Sons of Jove, the various local luncheon clubs and in many other ways they were all coming to meet and really know one another. Through their all honestly recognizing that where the line of demarcation was drawn as fine as it must be, in the electrical industry, and through open discussion and fair dealing and fair competition on the part of all, these differences were surely, though perhaps slowly, being eliminated.

Common sense would show any one the writing on the wall, which was clearly that individual prosperity could only come from the prosperity of all, and for the maximum prosperity it was necessary for all to work together. That the industry was awaking to the economic waste of absolute individual effort was demonstrated by the appearance in fifteen different newspapers of a Co-operative Electrical Page —a page in which all local and some national interests co-operated for the education of the public as a whole to things electrical.

By this and by the formation and successful operation in many different parts of the country of Co-operative Jovian Luncheon Clubs, which brought the various interests together for joint discussion and work which tended toward the development of the industry, and in many other efforts which were being made toward real co-operative work, Mr. Debevoise said that the interests of the manufacturer, the central station, the jobber and the contractor was each coming more surely to take his place in the continuity of effort which would give to the public a perfect and an economic service, which together with the efforts toward greater education, was developing rapidly and more rapidly the growth of the industry and the prosperity of all.

The meeting closed with a report of F. E. Watts, New York Jovian statesman and chairman of the club, that the committee appointed to carry out the publication of the Co-operative Newspaper Page in New York, reported that they had already arranged with two of the papers as to the rates, etc., and that work had commenced for arranging for space with advertisers and that the committee hoped that in the course of a very few weeks that all the space in the two papers would have been contracted for.

NEW CATALOGUES.

Descriptive Leaflet 2410, issued by the Westinghouse Electric & Manufacturing Company, describes the Westinghouse split frame commutating pole railway motor 323A. This motor has a rating of 32 h.p. at 500 volts and 38 h.p. at 600 volts.

Catalog No. 406 from the H. W. Johns-Manville Company is a 300-page substantially bound book on "Noark" Enclosed Fuse Protective Devices. This catalog forms a particularly safe and logical ordering channel for those having to do with the protection of electrical circuits.

The American Eveready Company are distributing an attractive catalogue showing the construction and method of operation of Eveready Portable and Stationary Meters for direct current designed for charging stations, power plants, automobiles, motor boats and laboratory testing.

Catalog No. 408 from H. W. Johns-Manville Company, sole selling agents for I. P. Frink, is devoted to Modern Illumination for Insurance Companies and Banks. Illustrations are given of a number of actual installations and drawings are shown of the application of Frink reflectors to a large number of illuminating requirements.

The March issue of Small Motors, issued by the industrial and power department of the Westinghouse Electric & Manufacturing Company, is devoted to electric motor vehicle. Considerable valuable information is contained therein with reference to the operation of these vehicles and their production of revenue to the central station.

"A Central Station Prophecy Fulfilled" is the title of a neat booklet from the Electric Storage Battery Company. This is of peculiar interest to central stations as it shows the actualities of the electric vehicle as a desirable load and the tremendous increase in the sale of electrics.

The General Electric Company has just issued an attractive publication relative to electric heating and cooking appliances and their application to the home, office and factory. This bulletin, No. 4921, is printed in two colors on heavy coated stock, and has a very attractive embossed cover. Many of the various devices are shown in use. The publication contains also a section devoted to wiring plans and wiring devices for the home.

The General Electric Company has issued several new bulletins. No. 4929 is devoted to the application of electric motors to the operation of brick plants. In this bulletin is shown the electric motor as used in the various operations of brick manufacture. Bulletin No. 4940 illustrates and describes that company's latest development of the commutating pole motor, known as type DLC. No. 4928 is devoted to commercial searchlight projectors. This bulletin describes not only the carbon arc projectors, but contains also illustrations and description of the incandescent lamp searchlights just placed upon the market.

INDUSTRIAL

THE NEW WESTINGHOUSE OVERSPEED LIMIT DEVICE.

A new overspeed limit device for rotary converters and motor-generator sets has been developed and will be furnished on all Westinghouse rotary converters built in the future, and, when especially ordered, on motor generators. Fig. 1 shows the application of the new device to the end of a rotary converter shaft and Fig. 2 illustrates the details. Advantageous features of the new device include its positive action, few parts, rugged construction and compactness.

The operation of the mechanism will be apparent from a study of Fig. 2. Normally the trip lever is held in the position shown in full lines by the trip-spring.

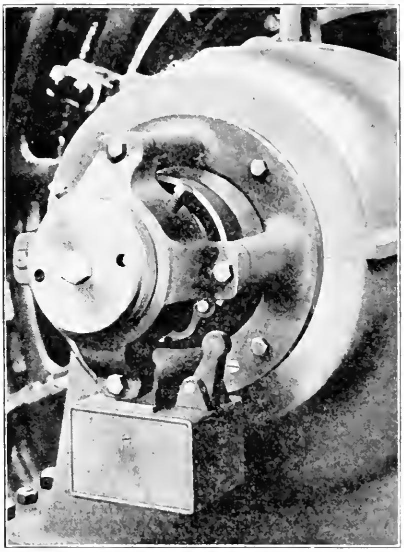


Fig. 1. New Overspeed Limit Device Installed on a Rotary Converter. An Oscillating Mechanism of the Standard Form is Also Shown.

If the speed of the machine exceeds the value (usually 15 per cent overspeed) for which the device is set, the trip lever, due to its centrifugal force, flys outward positively and quickly, and, knocking over the switch arm, closes the switch. A most interesting and important point in connection with its action is its positiveness. If the trip lever starts to fly out, the speed remaining constant or increasing, it will continue until it strikes the stop. This action is due to the proportions and disposition of the trip spring and the trip-lever.

The point on the trip-lever that strikes the switch-arm is approximately at the center of percussion of the lever, a fact which insures an effective blow being struck by the lever.

Normally the switch-arm is held in the open position by a toggle spring. The relation of the spring to the lever is such that the resisting torque of the spring is a minimum. When the trip lever strikes the switch-arm it forces the arm past the center point of the toggle mechanism and the switch, under the spring's tension, closes of itself.

It is only necessary for the trip-lever to move the arm a small distance, possible 3/32 in. to insure that the switch will close. The relation of the parts is such that, when the arm is in the closed position, the contacts are forced against the contact blocks with considerable pressure much more than is required to trip the switch.

To reset the switch it is merely necessary to move the switch arm back to the normal position by hand. This can be readily done at any time whether the machine is running or not and without opening the switch box.

That very few parts are involved is evident from an inspections of the illustrations. Obviously, the fewer parts in a mechanism the better it is, other things being equal. The minimum diameter for any bearing pin is ½ in., and the other parts are correspondingly strong. Adjusting screws are provided whereby the position of the trip lever can be closely

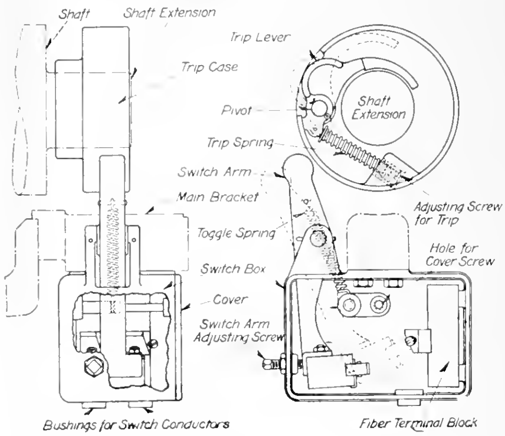


Fig. 2. Assembly Drawing of the Overspeed Limit Device.

regulated so that it will act at the predetermined speed. The sensitiveness of action of the switch arm can also be regulated by an adjusting screw.

Electrical connections for the new device will be the same as those used for the former Westinghouse standard overspeed trip arrangement. If the converter attains an overspeed the trip lever flys out, the switch arm forces its contacts against the contact blocks and an auxiliary circuit is closed. With the usual scheme of connections, the closing of this circuit energizes the solenoid of a tripping device (on the alternating-current circuit-breakers) which operates and opens the breakers, cutting the machine from its source of supply.

In addition to the overspeed limit switch illustrated, which must reset manually, another switch has been developed which can be reset by a solenoid arranged within the switch box. A circuit extends from the solenoid to the switchboard and the equipment is so designed that, after the switch has been tripped, it can be reset by closing the solenoid circuit with a contact button located at the switchboard or any other convenient point. This electrical resetting arrangement is not standard and is furnished only when specified by the purchaser.

The Westinghouse Electric & Manufacturing Company has received an order from the Seattle, Renton & Southern Railway Company, Seattle, Washington, for five complete cars equipped with five double No. 317 motors and AB USG control.

THE INCREASING USE OF THE TELEPHONE FOR TRAIN DISPATCHING.

The introduction of the telephone in the field of train dispatching still goes on with rapid strides. Its success has been emphatic and very gratifying to the officials on whose roads it has been installed. Of the railroads in the United States, which have adopted the telephone for handling trains, ninety per cent are using the well known apparatus manufactured for that purpose by the Western Electric Company.

The New York Central and Hudson River Railroad a month or so ago placed an order for forty-five telephone sets and miscellaneous supplies, to be used in extending their system; and more recently, placed a further order for seventy similar telephone sets, fifty-four transmitter arms, thirty portable telephone sets with the same number of line poles, sixty test panels and a considerable quantity of miscellaneous supplies.

In the West, the Davenport and Muscatine Railway Company, operating between Davenport, Iowa, and Muscatine, Iowa, a distance of about 25 miles, is installing a four selector and telephone way-station equipment, four selector semaphores and four siding telephones. In the South, another railway system to adopt the telephone is the Gulf, Florida and Alabama Railway of Pensacola, Florida, which has given the Western Electric Company an order for equipment for 100 miles of line. The apparatus to be furnished consists of twenty selectors, fifteen siding sets, twelve portable sets and the necessary line material.

Other railroads in the East and South, so it is reported, are constantly sending in "repeat" orders. The Lehigh Valley will install a special yard dispatching circuit consisting of eight complete selector stations, and have also ordered one hundred and forty portable telephone sets with line poles. A total of fifty-five wall telephones and miscellaneous material for train dispatching circuits is going to the Norfolk and Southern Railroad Company, while the Norfolk and Western has ordered ninety adjustaphones (transmitter arms) with the necessary generator sets and miscellaneous pole line hardware for two dispatching circuits.

The Chesapeake and Ohio is steadily extending its telephone lines and has recently installed forty-six additional desk type telephone sets with miscellaneous line material; and for use on the line between Columbus, Georgia, and Birmingham, Alabama, the Central of Georgia has ordered thirty portable sets and line poles. The Baltimore and Ohio will shortly install thirty-five additional way stati n outfits.

All in all, the past successes of the telephone in train dispatching are more than encouraging, and its future looms up brightly.

The old adage "An ounce of prevention is worth a pound ot cure," is rather shop-worn, but nevertheless it is as true now as when it was first written. Much has been said concerning the many ways in which the telephone has helped the railroads after an accident has occurred, such as getting information to headquarters and the starting of wrecking and relief expeditions to the scene of the disaster.

From the middle west there comes a tale which demonstrates that the telephone played an important part in an accident "that didn't happen." A track-walker on one of the trans-continental railroads in stepping back upon the right-of-way after a fast train had passed, noticed a broken flange, that had ripped off one of the wheels of a car, lying along the rails. What did this mean? It meant that one of the wheels was traveling at the rate of 45 or 50 miles an hour without a guide-band. It might go on through the entire journey without causing trouble, but, then again, in going around a curve, it might cause that particular truck to leave the rail and——; but why speak of the disagreeable.

The track-walker hastened to a siding switch, which was equipped with a Western Electric iron case telephone set, and told the dispatcher of his find. The dispatcher immediately telephoned ahead and had the train stopped, the damaged car removed from the tracks, and thus a possible accident was prevented.

A NEW PENDENT SWITCH.

"Dainty" is the word that best describes the new pendent switch just placed on the market by The Cutler-Hammer Manufacturing Company of Milwaukee. The brass shell, fashioned like an acorn, is only a trifle over 1¾ inches in height and a single switch weighs less than two ounces.

The attractive appearance of this switch and the remarkable reduction in size and weight have been attained without any sacrifice of serviceability. Removal of the cap (which is held in place by a snap lock) reveals a simple but rugged interior mechanism operated by a straight push-bar, similar to that used in Cutler-Hammer porcelain pendent switches. Ample terminal space is provided for wiring and the Underwriters' label testifies to the fact that the new switch has successfully met the rigid requirements of the Underwriters' Laboratories.

New Pendent Switch

The "Acorn" switch operates with a quick snap and the whole of the operating mechanism, except the projecting push buttons, may be concealed under a half-dollar. No porcelain is used in the construction of this switch, a new insulating material, developed in the ceramic laboratory of The Cutler-Hammer Manufacturing Company being used for supporting the operating mechanism. This new material is said to be unbreakable under ordinary service conditions and can be molded with much greater accuracy than porcelain, insuring proper alignment of parts and smoother operation when the switch is assembled.

The brass cap is designed to be snapped onto the shell and is provided with a hard rubber bushing which accommodates either standard or reinforced flexible cord. In spite of its small size the new switch has the usual ampere capacity for snap switches, being rated at 6 amperes, 125 volts or 3 amperes, 250 volts.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—A. G. Electric & Manufacturing Company, by A. G. Griswold, T. S. Lippy and others.

SEATTLE, WASH.—W. H. Shepard and a Mr. Cameron have incorporated under the name of Vancouver Monorail Company, with a capital of $10,000, for the purpose of building monorail roads in British Columbia.

BOISE, IDAHO.—The Snake River Power Company has been incorporated with capitalization of $900,000, by W. E. Pierce, J. A. Pinney and Willard White, the chief promoters. They will supply power and light to Boise and other cities.

SALEM, ORE.—Fred A. Jacobs, C. W. Hodgson and G. M. Shrock have filed articles of incorporation for an electric railway in Portland to connect with certain lines of the present system in Portland. The new line is known as the Errol Heights Railway Company. Capital stock, $20,000.

RIVERSIDE, CAL.—Articles of incorporation have been filed for the Riverside-Redlands Interurban Railway Company, with capital stock of $500,000. William S. Peloubet and Maurice Salxman of Los Angeles and R. E. Smith of Riverside are directors. Electric railway lines will be operated in Riverside, Redlands, San Jacinto and Hemet.

PETALUMA, CAL.—With the object of securing a coast outlet for the Petaluma and Santa Rosa Railway, articles of incorporation have been filed of the Petaluma and Coast Railway, which will run from Liberty on the line of the former road to Bloomfield and thence to a point on the coast near Bodega. The road will be 18 miles long and its headquarters will be in Petaluma. The capital stock is given as $250,000, divided into 2500 shares, and $22,000 has been subscribed. The five directors and the amounts of their subscription are: J. E. Alexander, $21,600; B. Levy, A. F. Hoehmer, D. S. Hyde and W. P. Ferguson, $100 each. The first four live in San Francisco and Ferguson in Santa Rosa.

TRANSMISSION.

CHEHALIS, WASH.—The County Commissioners postponed the granting of a franchise for a power line south of Napavine to the Washington-Oregon Corporation until April 1. With this franchise the company will go ahead with its line from Tenino to Kelso.

TACOMA, WASH.—The City Council has authorized Commissioner Hamilton F. Gronen of the department of light and water to apply to the county commissioners for a 25-year franchise for the transmission line of the Nisqually power project and for a telephone line.

BOISE, IDAHO.—The Great Shoshone & Twin Falls Water Power Company are making preparations for constructing a line from Mountain Home to Boise, to get into the local field. Application to the federal authorities for right-of-way has been made.

HUSUM, WASH.—A syndicate said to represent the Northwestern Electric Company has purchased a tract of 60 acres, located on both sides of the White Salmon River about three miles below here. It is claimed this will be the location of the proposed power plant of the Northwestern Electric Company, whose plant will cost $1,000,000.

LOS ANGELES, CAL.—By filing trust deed for $1,000,000 in the County Recorder's office, the Electric Power Company paved the way for erection of a big power house at headwaters of the San Gabriel River. Franchise rights for transmission lines through Angeles National Forest Reserve were granted the company several years ago. Filing of deed is last step in getting the work under way, according to Secretary Foreman. In addition to the plant several big flumes and tunnels will be constructed.

FALLON, NEV.—Sealed bids will be received by the U. S. Reclamation Service at Fallon, until 2 p.m. April 10, for distribution of materials and work of constructing to complete about 17 miles of electric transmission line extending from Lahontan to Fallon. The line consists of 35-foot poles, spaced 250 feet apart, carrying three No. 5 3-strand copper conductors on porcelain insulators, for transmission of 30,000-volt current. All materials furnished by the Government. Certified check of $200 is required with each bid, and bond of $500 is required of contractor. Further information may be obtained by calling on U. S. Reclamation Service, Fallon, Nev.

FRESNO, CAL.—The Pacific Light & Power Company has begun its plan of extension projected months ago by Henry E. Huntington, A. C. Balch and W. G. Kerckhoff, to make this corporation the greatest of its kind in Western America. The plans of the company and its expenditures in the building of the Big Creek power dam were recently announced. The railroad is to be used in connection with it in the Kern County district; and power lines will be strung all over Southern California to give light and power for electric railroads and cities. In furtherance of this scheme of extension the company has just closed a deal for the purchase of five local plants which will add greatly to the distributing outlet of current. The plants purchased are those at San Miguel, Paso Robles, San Luis Obispo, Arroyo Grande and Santa Maria. The price paid is in round numbers $1,000,000 and immediate possesion is given. It is the intention to bring the "juice" for these plants across the mountains from the big hydroelectric plants as soon as they are completed, thus connecting the coast power plants with those of the San Joaquin Valley. Improvements and additions involving an expenditure something like $3,000,000 are contemplated for these places and work will be commenced within the next few weeks of adding to and improving the local lighting and power systems in these cities.

ILLUMINATION.

LYLE, WASH.—Plans are under way for the construction of an electric light plant here. It is understood the light plant is to be financed by Le Roy Park, D. E. Keasey and their associates of Portland.

SACRAMENTO, CAL.—The rate war is on in the suburban districts between the Pacific Gas & Electric Company and the Great Western Power Company. Both companies are offering a cut rate for residents from 9c to 7c per kw. and to business houses a reduction from 8c to 5c per kw.

SAN JOSE, CAL.—Plans and specifications were adopted for the installation of 125 arc lights and a lighting system in the new College Park Lighting District, and the Clerk was authorized to advertise for bids for a five-year contract for power and the installation of the system, the bids to be opened April 15th.

TRANSPORTATION.

MARTINEZ, CAL.—The Board of Supervisors passed an ordinance granting to R. D. Rousfield, a citizen of the city of Berkeley, the right and franchise to construct and operate for a term of 50 years a single or double track street railroad in the southern part of Contra Costa county.

BELLINGHAM, WASH.—A railway line from the city limits to Geneva will probably be built. Inducements in the way af right-of-way and money are being made the street car company.

MILWAUKIE, ORE.—The Southern Pacific Railway is asking for an ordinance for electrifying its line which passes through Milwaukie and crosses the Willamette River at Oswego, known as the Beaverton cut-off.

FAIRFIELD, CAL.—The Vallejo & Northern Railroad Company have been granted a franchise to construct, lay down and operate by means of electricity a single or double track railroad in certain streets in this town.

GLENDALE, CAL.—E. D. Goode has secured right of way for a railroad which will run from Fourth street and Brand Boulevard, Glendale, west on Fourth street to Pacific Avenue, south on Pacific to Oak drive, thence on Oak drive west to and across the Los Angeles River, connecting with the southern end of aviation field. It is expected the line will be constructed and in operation in four months.

SAN FRANCISCO, CAL.—Mayor Rolph and the members of the Supervisors with J. R. Bibbins, the traffic expert; Michael Casey of the Board of Public Works anod City Attorney Long personally inspected the route of the Geary-street municipal railway. At the conclusion of the inspection the Supervisors decided to ask Bion J. Arnold and J. R. Bibbins, the traffic experts, to render a report as to the best route to be used, considering the engineering and operation problems involved, and the revenue to be produced.

VISALIA, CAL.—An announcement has been made to the effect that the Tidewater & Southern Railway, now in the course of construction between Stockton and Turlock, is to be extended through the Alta section of Dinuba to Visalia. The new electric railway is under contract to be in operation into Turlock by July 4th and into Fresno by January 1, 1913, so that Visalia is expecting to see trains running to this city in less than a year. It is the plan of the road to run from Fresno south through Selma to Dinuba, thence through Orosi and Yettem to Visalia, and from this city south to Tulare, thence east to Lindsay and Porterville and south to Bakersfield, the present terminus.

SAN FRANCISCO, CAL.—Mayor Rolph is determined to see construction work begun at once on the car barns and substation of the Geary-street road. When the public utility committee hesitated about its authority to order the preparation of plans Rolph assumed full responsibility. City Engineer Loren Hunt stated that the amount already expended and contracted for is $562,000, which includes all material purchased or ordered for the road from Fifth avenue to Kearny street. The total construction will cost $2,980,000. For track construction $100,000 has been spent and $400,000 remains to be expended. Hunt estimated that the track construction can be finished in six months.

RICHMOND, CAL.—That the Southern Pacific Company contemplates the extension of its electric suburban system on the east side of the bay to Richmond is indicated by a map filed with the County Surveyor at Martinez which provides for an electric railroad through the Henderson tract to connect the Southern Pacific's electric lines in North Berkeley with the Cutting boulevard. H. C. Cutting has applied to the City Council for a franchise for an electric line to extend over the boulevard from its easterly end to the business center of Richmond. It was generally supposed that he expected the Key Route to build this road, but it is now understood that the Southern Pacific will do so.

COLUSA, CAL.—Maney Bros. have sublet contracts for the grading of the Marysville-Colusa branch of the Northern Electric. Harlan Bros. of Williams have the section from Terra Buena to a point a few miles east of Sutter City. The next section from the Humphrey place to Sutter City will be handled by C. Bell, who has been doing the grading for the Sacramento Woodland Electric line. The work from Sutter City to the Lon Summy place will be handled by J. Hennigan. The section from the Summy place to Butte Slough has not been arranged for as yet. From Butte Slough to a point half way across Reclamation District 70 will also be done by Hennigan, and from Meridian to Colusa on the west side of the Sacramento, the contract has been awarded to Harlan Bros.

VANCOUVER, B. C.—The British Columbia Railway Company has placed an order for 24 interurban cars with the St. Louis Car Company, the additional rolling stock, with electrical equipment representing an outlay of $250,000. Twenty-two of the cars are intended for passenger service. The company has prepared plans for a new substation on Earl's Road, South Vancouver, for the regulation of its light and power service in that district as well as on the Westminster interurban line, along which the station is located. The electrical equipment will consist of two 1000 kw. motor generator sets, two banks of transformers of 3000 kw. each for light and power service, eight arc regulators with a total capacity for 800 lamps and a switching station for a 10,000 volt feeder switch. The total investment at the point will be $125,000.

SAN FRANCISCO, CAL.—Bids for the construction of the municipal railroad on Geary street from Fifth avenue to Kearny street were opened March 27, by the Board of Public Works. There was considerable variation in the bids. The lowest was submitted by Bates, Boland & Ayer, its amount being $225,025, and the next was that of the State Construction Company, $253,110. The other bids, there being ten in all, were: Mahoney Bros., $283,845; E. B. & A. L. Stone Company, $295,370; Healy-Tibbits Construction Company, $297,350; Contra Costa Construction Company, $321,640; Willett & Burr, $332,920; City Street Improvement Company, $314,458; Chadwick & Sykes, $349,790; Grant, Smith & Co., $361,770. The Board approved the specifications submitted by the city engineer for the sub-station which is to be built at the car barn of the municipal railroad.

TELEPHONE AND TELEGRAPH.

PLANADA, CAL.—Planada is to have a telephone system in the near future. J. Harvey McCarthy will promote the new enterprise.

TACOMA, WASH.—The franchise of the Home Telephone Company has been revoked by the City Council. It cost the company $550,000.

CHEHALIS, WASH.—The Saint Urban Telephone Company has been granted a franchise for 25 years to erect and maintain poles on certain county roads.

LAKEPORT, CAL.—The completion of the organization of a new farmers' telephone company has been effected at Upper Lake, practically assuring the carrying out of a plan which for some time has been entertained of building a grounded line from Upper Lake to Lakeport. Actual construction of the line will be commenced as soon as the poles can be secured from Polk's mill.

SAN FRANCISCO, CAL.—The first legal attempt to block the sale, transfer and merger of the Home Telephone Company was begun Saturday when O. L. Scott, a tailor, through his attorney, applied for a restraining order before Superior Judge Lawlor to prevent the consummation of the transaction. On the application of Attorneys Albert L. Johnson, Wiley F. Crist, C. W. Eastin and Ferno J. Schuhl, representing Scott and various organizations in the city, Judge Lawlor granted a temporary injunction and set the time for hearing as next Saturday morning at 10 o'clock. At that time the restraining order will either be made permanent or will be dissolved.

SANTA MONICA, CAL.—Officers of the Santa Monica Bay Chamber of Commerce have discovered that the Sunset Telephone Company has no franchise in Venice, and the

City Trustees will be asked to compel the concern to combine with the other phone service or cease operation. The victory of Pasadena under similar circumstances is cited as the precedent that makes the position of the Venice Board impregnable. The Santa Monica Bay Home Telephone Company is ready, say officers of the commercial body, to enter into any reasonable agreement with the other company that may be offered. Mayor Dow tried to begin proceedings for a single telephone service in the beach district, but the report of that action must begin in Venice. The Santa Monica Council will be asked, however, to lend co-operation.

SAN FRANCISCO, CAL.—Declaring it to be against public policy that the Home Telephone Company should be merged with the Pacific Telephone & Telegraph Company and calling an election to determine whether or not the city should issue bonds in the sum of $6,000,000 for the purchase of the Home company's plant, the result of last week's special election does not finally settle the question at issue, as it merely calls another election for the purpose of determining whether the city shall buy the Home's plant. For the first proposition declaring it to be a public necessity for the city to acquire a telephone plant, and that the public interest requires that the proposed merger of the two companies be defeated, the vote was 21,174 for and 10,353 against. On the second proposition, which is in the form of an ordinance calling a special election on the question of incurring a bonded indebtedness of $6,000,000 for the purchase of the plant of the Bay Cities Home Telephone Company the vote stood 20,500 for and 10,665 against. This vote falls short of giving the two-thirds majority which would have been necessary had this election been for the purpose of directly deciding the question of the purchase of the Home company's plant by the city.

WATERWORKS.

TACOMA, WASH.—Water meters are to be placed in factories, hotels, laundries, livery stables, barber shops and creameries in this city.

BOISE, IDAHO.—The Boise Artesian Hot & Cold Water Company will within the next three months spend $100,000 in Boise in the laying of water mains, and the construction of a mammoth reservoir.

OROVILLE, CAL.—Announcement that work on the construction of the dam at Big Meadows would begin April 15 was made by Jesse Baumgardner, superintendent o. hydraulic construction for the Great Western Power Company.

SAN DIEGO, CAL.—May 7 is the date which has been fixed to hold an election for the issue of $680,000 in bonds to extend sewers, water mains, and make certain improvements to streets, which includes building and repair of bridges.

CENTRALIA, WASH. At a meeting of the City Commissioners in Centralia an ordinance providing for the installation of a municipal gravity water system passed final reading. The election to vote bonds with which to construct the plant will be held on May 7th.

TACOMA, WASH.—Preparations for the letting of a contract as soon as possible for the final unit of the Green River gravity system which will connect the pipe on Wright avenue with the J street standpipe, are being made. This final unit will cost about $140,000.

GRASS VALLEY, CAL.—Despite recent rains all mining companies have been notified by water companies that no power can be furnished after June 10. The supply is only sufficient for the towns in this section. The larger mines probably will install electric power.

WILLOWS, CAL.—The Northern California Power Company, which owns the local water system has closed a deal for the purchase of a two-stage centrifugal pump which will practically double the capacity of the plant. The pump will be operated by a 30 h.p. electric motor.

RAYMOND, WASH.—This city has employed an expert engineer to estimate the probable cost of a municipal water system. It is proposed to take over the private plant and enlarge and improve it by laying heavier mains and building a reservoir with a capacity sufficient for the needs of the city.

LOS ANGELES, CAL.—The cities to be served by the Owens water distribution are: Pasadena, South Pasadena, Alhambra, Santa Monica, Venice and smaller communities lying between Los Angeles and Crescent bay, an area of 195,000 acres. Pipe lines are to be divided into four cases by the engineer and with each case is carried the route and estimated cost.

LOS ANGELES, CAL.—The Tejunga Water & Power Company will expend $1,000,000 which it has secured through a deed it has executed through the Los Angeles Trust and Savings Bank. The Owensmouth, the Marion and Van Nuys Water Companies have also taken trust deeds through the Title Trust & Insurance Company, calling for an increased indebtedness of $50,000 for each company.

SUTHERLIN, ORE.—At a special meeting of the City Council the contract for digging a large well, constructing a reservoir and installing a distributing system of waterworks was awarded to Jeffery & Bufton of Portland for $14,881.15. The distributing system includes six in. mains on the principal streets with numerous hydrants for fire purposes. The reservoir is to be of concrete and of 50,000 gallons capacity.

GLENDALE, CAL.—The City of Glendale has entered into an agreement to purchase the waterworks from F. H. Sine. At the earliest possible moment a meeting will be called to decide upon the issue of $15,000 bonds to cover the purchase of the waterworks and also at the same town meeting the full particulars regarding the purchase of the electric light plant will be brought forward and decided upon.

OREGON CITY, ORE.—The Common Council of the City of Gladstone, will receive bids for the purchase of $20,000 of the negotiable coupon bonds of said town bearing 6 per cent semi-annual interest from the date of issue. The bonds are for the purpose of building and maintaining a water system in said city. Bids are to be received and filed with the recorder of said city at any time before 7:30 p. m., April 9, 1912.

EL PASO, TEXAS.—The Guadalupe Water Power Company of Seguin, Tex., recently formed with a capital stock of $600,000 will construct a series of dams and hydroelectric plants on the Guadalupe river between that place and New Braunfels. The same interests are working to form a company to construct an interurban electric line between Seguin and New Braunfels and San Antonio. W. J. Crawford, W. B. Dunlap and J. M. Abbott are interested in the project.

MODESTO, CAL.—By the introduction of an ordinance providing for the issuance, sale and redemption of $5,500 water bonds at the City Council meeting recently and the appointment of F. C. Roberts of the firm of Roberts & Denicke, expert engineers, of San Francisco as consulting engineer for the work, Modesto commenced actual steps on the re-organization and improvement of the municipal water system. The plans provide for the erection of steel tanks with a total capacity of 300,000 gallons, the installation of new and powerful pumps and the laying of a larger and more effective distributing system.

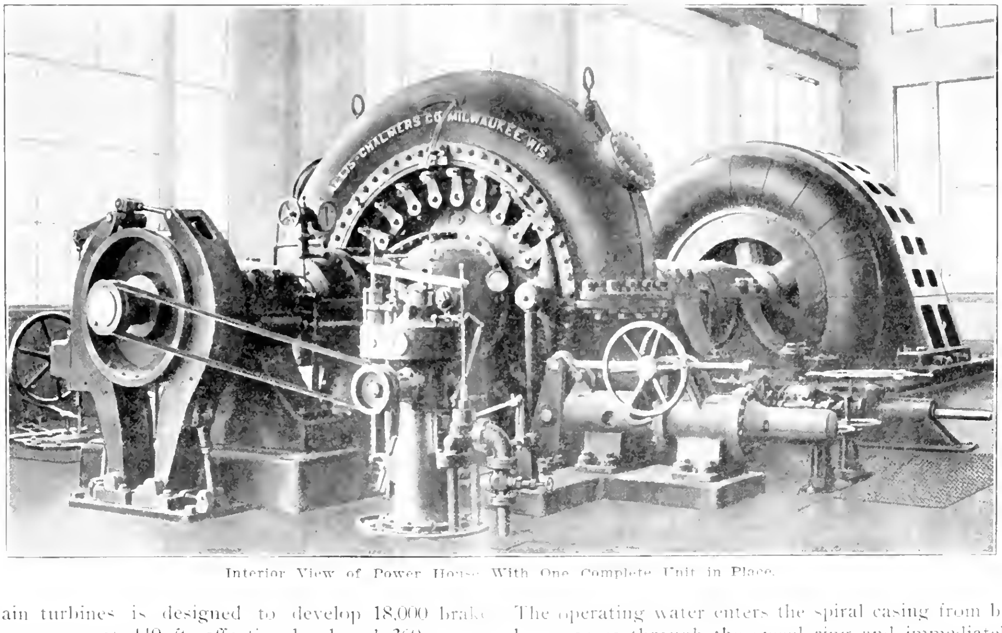
Journal of Electricity
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

Volume XXVIII SAN FRANCISCO, APRIL 13, 1912 Number 15

THE WHITE RIVER PLANT

BY ARNOLD PFAU

About a year ago the Pacific Coast Power Company, of Seattle, now a part of the Puget Sound Traction, Light & Power Company, awarded the contract for the largest hydraulic turbines ever contemplated, the installation being made at their White River power plant about 20 miles east of Tacoma. Each of the two main turbines is designed to develop 18,000 brake horsepower at 440 ft. effective head and 360 r.p.m., but is also capable of delivering 20,400 brake horsepower at a maximum head of 480 ft. and synchronous speed of 360 r.p.m. All parts are designed to withstand the runaway speed at the maximum head of 480 ft. without undue strains upon the material employed. This is the largest high head (reaction) Francis turbine yet designed. The generators are 12,500 k.v.a., 20 pole General Electric water-wheel type alternators supplying three-phase 60 cycle current at 6600 volts. They are connected to their turbines by a rigid flanged coupling.



Interior View of Power House With One Complete Unit in Place.

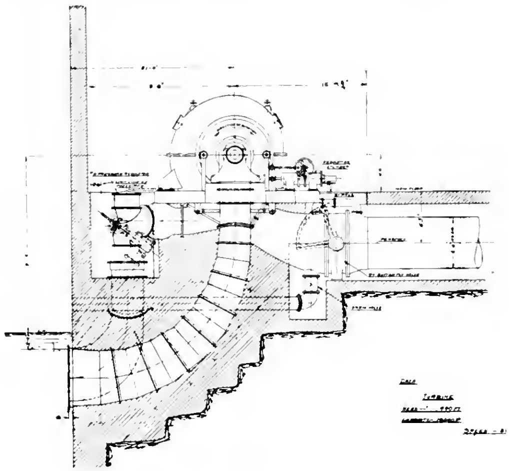
The turbine is of the inward flow (reaction) type as developed by the Allis-Chalmers Company. To comply with the special wishes of the purchaser, the spiral-case-double-discharge arrangement was adopted. The operating water enters the spiral casing from below, passes through the speed ring and immediately upon entering the runner is divided in two discharges with separate quarter turns and steel plate draft tubes.

The spiral casing is made of two halves rigidly bolted together in a horizontal plane through the center line of the shaft. It is made of cast steel to withstand a test pressure of 385 lb. per sq. inch, and is annealed to increase its resistance against any positive and negative pressure variations which may occur in exceptional cases of severe load changes. Proper man-

holes are provided and also taps for pressure gauges, pitot tubes for research work. Opposite the inlet pipe an outlet branch pipe is provided which connects to the Y pipe of the pressure and the governor operated pressure regulators.

This spiral casing has a span of 16 ft. and diameter of inlet pipe of about 5 ft., being the largest cast steel casing ever built for use with a head over 400 ft., and consequently a number of interesting problems had to be solved by the designers, in order to insure economy in manufacturing, and at the same time employ the proper amount of material to withstand the stresses caused by the tremendous resulting forces within safe limits.

The water passing through the spiral casing enters the speed ring in approximately radial direction. It thus leaves the inner ring of the casing open and would impose considerable strain upon the material. To efficiently reduce this strain a speed ring of annealed cast steel is bolted to the inner opening of the



Plan of 20,000 H.P. Turbine Installation.

spiral casing and through its substantial webs forms a solid cross connection without obstructing the water passages.

The two inner flanges of the speed ring carry the speed gate covers, which are bolted to the quarter-turns and bored out to receive the bronze bushings forming the bearings for the pivoted guide vanes. The inner radial faces are lined with removable facing rings, which are subject to wear due to the grinding effect to be expected on account of the existence of glacial silt carried by the "White River," from which this plant is operated.

Due to the high velocities allowable in spiral cases under high head, special care must be taken that all obstructions to the free water passage are avoided and it is therefore, necessary to keep all moving or sliding elements outside of the casing where they can be readily inspected and lubricated. The so called "outside gate rigging" has, therefore, been adopted.

If any foreign matter between two guide vanes prevented their closing, the governor would concentrate its full energy upon these two guide vanes and their stems, levers and links and would deform and damage them unless they are proportioned accordingly. This would call for dimensions of stems which would seriously interfere with the proper design of the guide vane bodies and unnecessarily increase the friction of the whole gate rigging. The guide vane stems and levers are, therefore, proportioned to only resist the pressure and strain resulting from the water pressure. To prevent the governor from imposing destructive strains upon the connecting links between shifting ring and guide vane levers, the links are made of such a cross section as to break at a predetermined stress. The levers are easily removable so that an exchange of links can be effected in a very short time.

The guide vanes are so designed that they have a tendency to close to an opening at which the turbine will operate without load at about normal speed. A breakage of two links can, therefore, not materially affect the speed of the turbine and the two links may, therefore, be exchanged without necessitating a shut down of the unit.

The runner is made of one solid steel casting carefully machined, perfectly balanced and the water passages made to template so that the actual areas deviate fractions of a per cent only from the working drawings. The runner is bolted to the concentric flange of the turbine shaft and the units are locked and protected against corrosion from the discharging water by means of machined cover rings which at the same time form a smooth guide and, together with the walls of the quarter turns, insure correct flow lines of the discharging water columns.

The cast iron quarter turns are of liberal sweep split vertically to enable quick access to the discharge side of the runner and being bolted to the base plate, rigidly brace the turbine casing and thus increase the stability of the whole unit. Proper manholes are provided for inspecting the interior.

The shaft is of solid open hearth forged steel and rests in two generator type ball and socket seat ring oiling bearings. The driving end in the bearing has a diameter of 16 inches, increasing to 32½ inches at the center flange to which the runner is bolted. The opposite bearing serves as a thrust and steady bearing, three substantial thrust collars being forged with the shaft in one piece.

An automatic water sealed box has been adopted and is so arranged that it may operate either at over-pressure in the quarter turn or under vacuum. Revolving disks are combined with stationary chambers connected to either circulating water pressure supply or to drain pipes connected to the draft tubes.

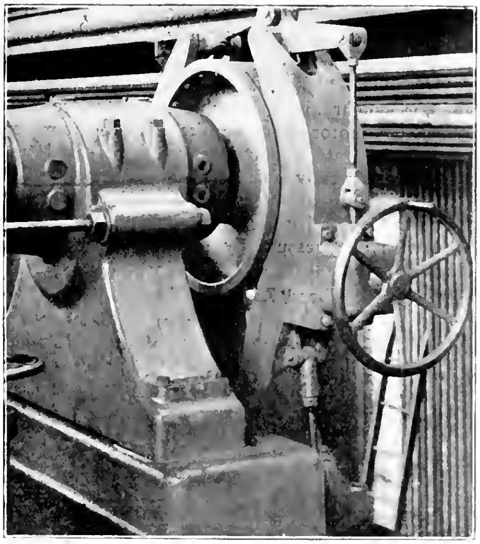
The end thrust caused by turbines of such size and power would, if taken up by mechanical thrust bearings, call for dimensions which are commercially prohibitive. It is, therefore, necessary to balance the revolving element automatically. This is relatively easily accomplished with double discharge runners of the type used here. The speed gate covers, which also serve as discharge rings, form pockets between the covers and the runner walls and are so designed

that the runner floats inside on pressure cushions which in themselves are powerful enough to counteract any mechanical end thrust which may ever be caused by the runner.

The base plate forms the top of the drain tubes, and the steel plate draft tubes proper are bolted to the base plate by means of angle steel flanges. The draft tubes are all concreted into the foundation. They form a tapered elbow of long curvature and lead the discharge water horizontally into the tail race pit outside of the power house.

Hand-Operated Friction Brake.

The turbine shaft carries the friction brake pulley and the brake yoke is mounted upon the extended foundation base plate. This brake is designed to bring all the revolving elements, at closed turbine gates with



Mechanical Handbrake for 20,000 H.P. Francis Turbine.

casing under full pressure, to a stop from full speed in five minutes and the friction surface and pressure is such that under the above conditions all the heat produced is safely carried off to prevent excessive heating.

Butterfly Valves.

Since each main turbine has its independent pipe line it was not necessary to provide for a gate valve, because the feeder pipe belonging to this unit can be emptied without interfering with the other unit. In case of accident, however, where a quick closing off of the water supply is imperative it is desirable to have some means in the power house for immediate action. For such purpose a butterfly type of valve is very satisfactory, provided that it is so designed that it is sufficiently tight to enable inspection of the interior of the entire turbine.

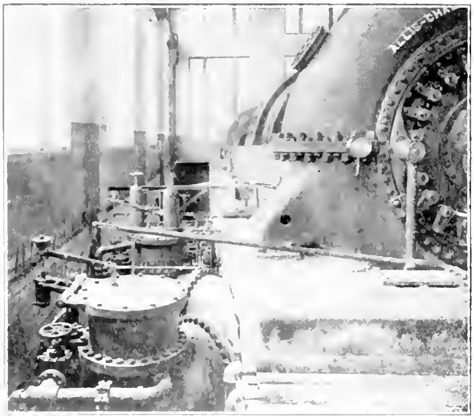
A cast steel butterfly of 84 in. free passage diameter is, therefore, inserted between the feeder pipes and the turbine. It is located below the power house floor and connected to the taper inlet pipe between the same and the spiral casing.

The gate can either be operated by a mechanical hand regulating device or by a direct current motor with starter, either close to the turbine or from the switchboard gallery. Under normal conditions a bypass valve may be opened for filling the turbine casing and balancing the butterfly valve, in which case a gear ratio is used by means of which the valve can be operated quickly.

A drain valve is placed at the lowest point of the inlet pipe by means of which the whole unit can be completely drained, or the leak water discharged.

Regulating Cylinder and Mechanical Hand Regulating Device.

Economy of water is of main consideration with the operation of this power plant. It is, therefore, logical to use water for controlling the load fluctua-



Governor and Pressure Regulators 20,000 H.P. Francis Turbine.

tions of the power system. Special attention had to be paid to the problem of speed regulation, and all parts concerned are designed and built for the highest economy and reliability. The horizontal regulating cylinder is mounted upon the main base plate of the turbine by means of two substantial brackets, one directly supporting the regulating cylinder and the other supporting the guide of the crosshead of the regulating piston. The piston rod projects through the front and rear cylinder covers, carrying at its rear end a gate opening indicator and at its front end a substantial cross-head which receives that component force which results from the inclined position of the connecting rod between cross-head and regulating lever at mid and end positions of the regulating piston.

To enable inspection or repair of the regulating piston or other parts of the governor without necessitating a shut down of the whole unit, an independent mechanical hand regulating device is used, placed above the regulating cylinder and so connected with the extended regulating lever that it can be conveniently thrown in or out of commission.

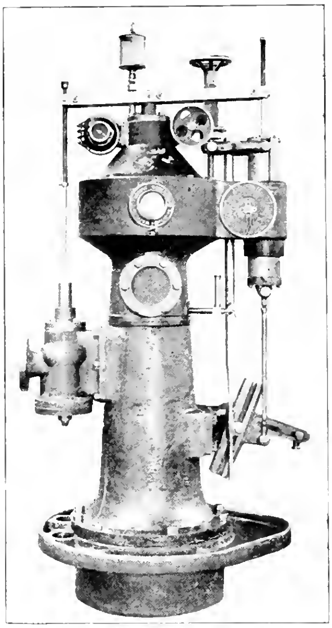
In power plants with units of such size and a power system of such magnitude, it is permissible to have one or a few units operating on the line without taking part in the speed regulation. An independent mechanical hand regulating device is, therefore,

of considerable commercial value in so far as it permits the use of the unit and the furnishing of power even during inspection or repairing of the automatic governor.

Automatic Governor.

The governor is of the oil pressure type, the operating oil being furnished by a central oil pressure system.

The governor stand is conspicuously located on the generator floor. It carries the speed control or flyballs, the floating lever, regulating valve, compensating-relay-dash-pot and synchronizing attachment or switchboard control. The flyballs are completely encased so that no revolving parts are visible except the flyball drive pulley. They are of the equilibrated spring type, of extreme sensitiveness and stability with springs adjusted in strict accordance with the characteristics required. The governor motion is transmitted on top of the housing to the floating lever. A sight feed oil cup of liberal capacity enables continuous and perfect lubrication of all revolving elements so that highest sensitiveness together with maximum energy is obtained. The regulating valve is double acting and hydraulically balanced so that practically no energy is required to raise or lower the valve stem connected to the floating lever. Since the flyballs are extremely sensitive and at the same time produce considerable energy, it is evident that the smallest speed variation will suffice to move the regulating valve stem and consequently the gates of the turbine. A speed variation of 1/5 of 1 per cent is sufficient to cause a motion of the gates so that the speed regulation will be of the highest accuracy obtainable. The regulating valve is returned into its mid or "dead beat" position by means of the floating lever operated from the compensating relay dashpot. The dashpot receives its motion from the relay connection of the regulating piston. The compensating relay is a combination of a relay of fixed long stroke and a relay of short adjustable stroke so connected to each other that the large stroke acts first upon the floating lever and the small stroke acts relatively slowly thereafter, thus gradually readjusting the position of the floating lever to that of the small relay stroke and consequently of a small difference between the former speed and the present one corresponding to the new load or gate opening of turbine. The small secondary relay stroke can be adjusted according to the desired maximum speed difference between friction load and full load of the turbine, and can be set for any percentage between 4 and 0, the latter, however, is not possible for alternating current generators running in parallel with each other as the total absence of speed variation would cause a floating of the load between the generators concerned.


Hydraulic Turbine Governor.

The synchronizing attachment control consists of a small d.c. motor operating the relay of the governor so that the gate opening may be increased or decreased electrically from the switchboard and thus a synchronizing of the units is made possible. The relay can also be hand operated and the turbine regulated with oil pressure by hand from the generator floor.

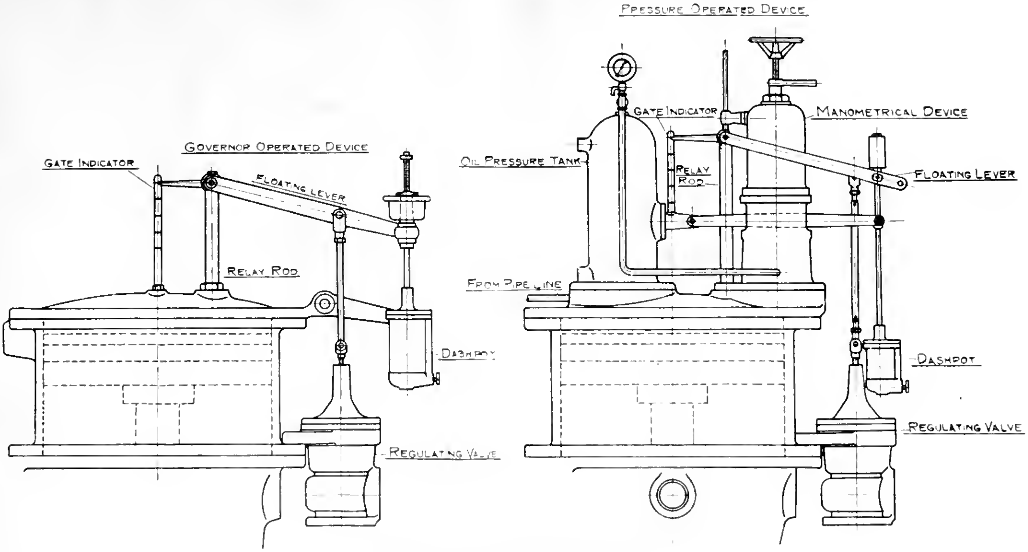
Load Limiting Device.

In order to limit the maximum gate opening of the turbine, when regulated automatically, a load limiting device is provided so that the governor is prevented from opening the turbine gates beyond a desired amount. A lever and adjustable rod is connected to the relay shaft and operates a fork which prevents the valve stem from dropping below a certain fixed position. The adjustment of the length of this rod determines the desired limit of gate opening.

Governor Operated and Pressure Operated Pressure Regulators and Bursting Plates.

In order to protect the pipe line against serious pressure rises and to assist the governor in obtaining close speed regulation, devices must be provided to prevent pressure rises or surges of the water column. This is accomplished by the use of pressure regulators which are both governor and pressure operated, and to protect the pipe line in case of failure of either of these devices, a bursting plate is provided.

The pressure regulators are of Allis-Chalmers Company's typical design. A "Y" pipe is connected to the bottom branch of the spiral casing below the generator floor. One branch of this "Y" pipe leads to the governor operated pressure regulator, the other to the pressure operated pressure regulator and the neck of the "Y" pipe connects to a hand operated gate valve which at its lower end, carries the bursting plate and its discharge pipe. While the discharges of the two pressure regulators are united by a "Y" to a common flaring steel plate elbow, for reasons of economy of space available between the two turbine draft tubes, the discharge pipe from the break plate empties independently into the tail race pit.



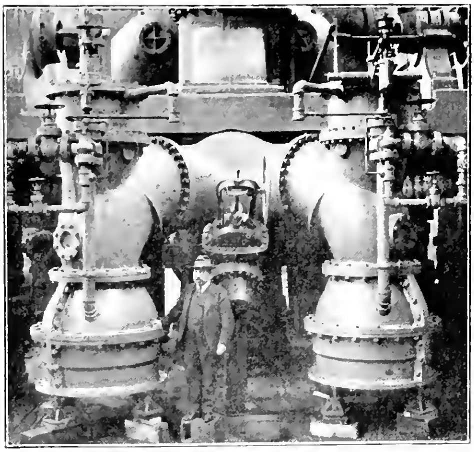
Details of Governor Operated Device.

Both pressure regulators consist of a main valve and of the mechanics to operate it. The main valve is of identical design with both pressure regulators while the mechanisms attached to it are governor operated in one case and pressure operated in the other.

The main valve consists of an elbow which, at its lower joint, holds a circular bronze bushed ring against which is pressed a flaring disk held up by a stem connected to a piston located in the bronze bushed cylinder above the elbow. When the disk is lowered the water discharges vertically downward and the shape of the discharge ring and the disk valve is made so as to cause a flaring discharge of the water and thus tends to spray it. This results in an efficient reduction of the impact. The load resulting from water pressure upon the disk tends to open the valve but is counteracted by the pressure below the piston mentioned before.

The adjustment of this pressure is accomplished by a regulating valve attached to the cylinder and this valve is operated either by the governor actuated or by the pressure actuated device.

The regulating valve receives the operating water from the pipe line. Although its design is free of intricacy which would render its safe operation questionable the operating water is filtered by a pair of cylindrical screens inserted between the valve and the pipe line. These filters are so designed and connected up that either one can be cut out and automatically cleaned without requiring dismantling and without interfering with the operation of the pressure regulator. The piping is so arranged that pipe line pressure can be directly admitted below the main piston so that the disk of the pressure regulator is held closed while the regulating valve is removed for repair or opened up for inspection. The principle arrangement of these two pressure regulators is shown in the illustration. The device consists of a piston held strictly under the existing pipe line pressure and balanced by a strong steel spring, the compression of which can be adjusted by screw and hand wheel. This piston operates a lever which at its outer end carries the stem of the regulating valve. Any pressure rise will cause a compression of the spring, consequently an upward motion of the piston and the regulating valve piston. The disk valve is opened and,



Governor and Pressure Operated Pressure Regulators and Bursting Plate

actuating the floating lever, will restore the regulating valve to its former position, thus holding the disk valve dead beat. The dashpot connected to the outer end of the floating lever allows a gradual closing of the pressure regulator similar to that of the governor operated device.

To prevent the sand from interfering with the sensitiveness of the manometric device (piston and spring) the water pressure is not directly admitted to

the cylinder but is carried into a pressure tank completely filled with oil so that this oil under pressure transmits any fluctuation to the manometric device and, due to its lubricating qualities, keeps the same in perfect condition and sensitiveness. The pressure tank has an oil glass by means of which it can be ascertained whether there is sufficient oil available to prevent the water from entering the manometric device.

Special care has been taken in the design and construction of the bursting plate and the tests to determine the proper dimensions of the bursting disk proper have shown a surprising accordance with the results figured theoretically.

Exciters.

Excitation current is supplied to the generators at 240 volts by two 225 kw. machines driven at 400 r.p.m. by impulse water wheels with hand adjustable needle regulation and governor operated deflecting hood.

The governor is of the self-contained Allis-Chalmers Company oil type. It is not connected to the central oil pressure system but furnishes its own oil pressure for regulation. This enables independent operation of the exciter units so that the field can be held on the generators irrespective of the conditions of the governors of the main unit.

The main body of the governor forms the oil tank and contains the differential regulating cylinder and piston, directly connected to the regulating shaft by means of levers and links. Attached to the body is the rotary oil pump which is belt driven from the exciter shaft and furnishes a continuous oil supply sufficiently large to handle the whole piston displacement in the minimum time required for deflecting the jet. A double acting regulating valve it attached to the outside of the pump housing. It is actuated from the floating lever, operated from the belt driven flyballs in the mid part and the relay at its outer end. The flyballs are of the equilibrated spring type of high sensitiveness and power.

The regulating valve is so designed that if placed in mid position, it allows the oil displaced by the pump to return into the receiver at a moderate over pressure.

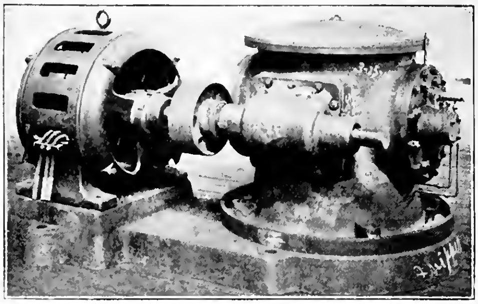
The governor is also equipped with a mechanical hand regulating device combined with the regulating piston at the rear of the regulating cylinder.

Central Oil Pressure System.

A type of pump has been adopted which, although not of the highest efficiency, is preferable on account of its reliability and simplicity. It is of the rotary type and has been brought to a remarkable degree of perfection. Three pumps are installed at present, each of a normal capacity of 90 gallons per minute against a pressure of 400 lb. per sq. in. Two are directly coupled to a 85 h.p. induction motor. The third one is also coupled to such a motor on one end and to an independent small impulse wheel of corresponding power on the other side. Pump and motor are mounted upon a common cast iron base plate grouted into the concrete floor.

The rotary pump is of the double stage type, one pump attached to one side of the cast iron housing picks up the oil from the receiver tank and discharges it at about 200 lb. pressure directly into the suction side of the high pressure pump attached to the housing on the opposite side. This pump raises the pressure from 200 lb. to 400 lb. per sq. in. and discharges into the pressure main.

The distribution of the oil pressure between the two stages is easily adjusted by a by-pass which, if once set, will require no further adjustment or attendance.



Two Stage Rotary Oil Pump.

The gears are a pair of pinions with a special design of teeth, meshing without clearance and with faces fitted carefully together with the faces of the pump housing. One pinion revolves idly around its pivot, the other pinion is keyed to the shaft which carries the driving pinion of the other pump on one end and a double helical gear in the middle. The double helical gear meshes into the driving pinion keyed upon a shaft, revolving in two rigid ring oiling bearings, and carrying a coupling on its end for rigid connection to the motor or to the impulse wheel. Special care was taken to insure perfect and reliable lubrication of all bearings. This is accomplished by automobile lubrication, whereby a small quantity of the oil pressure produced by the pump is directly used and forced through the bearings.

Exhaustive tests were made at the shops with these pumps, both in regard to capacity and efficiency as well as to heating. At a normal speed of 180 r.p.m. of the pump gears and a discharge of 98 gallons per minute against a pressure of 350 lb. per sq. in., an efficiency of the pump of 50 per cent was obtained, and air was compressed to 350 lb. per sq. in. without undue heating and with absolutely noiseless operation. The pump was also operated for a period of one hour against a pressure of 425 lb. without causing undue heating or noise.

Sufficient space was available in the basement of the power house so that all pumps, pressure tanks and receivers could be located in a compartment below the generator floor, and all pipes from and to the governors and equalizing pressure tanks are carried directly below the main floor through the basements which are easily accessible. The three pumps are set with the driving shafts in one line and provision is made for installing a fourth pump which will be required for the ultimate number of six main units.

The pumps located in the center are built sym-

metrically so that the auxiliary impulse wheel located between them can be coupled to either of the two gear shafts.

Two independent receiver tanks of steel plate are provided. They are partly set in to the basement floor, so that all oil can discharge into it by gravity. Provision is made for liberal contact of the oil with air, the oil returning from the governors or safety valves discharges over a screen whereby it frees itself of air and all impurities, as well as heat. The two receivers are interconnected by a pipe with proper valves so that the oil can be transferred from one tank to the other or the levels kept uniform. They are of ample capacity so that one receiver is capable of carrying sufficient oil for the whole system, while the other receiver may be emptied for cleaning.

A substantial concrete pier between the two receivers carries the two main pressure tanks. These tanks are made of riveted steel plate and tested to 600 lb. per sq. in. with a capacity of about 250 gallons each. A safety valve of the spring type is attached to each pressure tank and, set to any desired pressure between 300 lb. and 400 lb. per sq. in. discharges excess oil directly into the receiver. This safety valve is so designed that the valve proper can at any time be manipulated from the outside, so that the operator can always ascertain whether the device is "free and sensitive."

All piping between pumps, pressure and receiver tanks is so arranged that any combination of connection between the various elements can be established at any time during operation. It is thus possible to quickly eliminate any element of this system.

One main pressure pipe and one main return pipe carry the oil from the pressure tanks to the main governors and from there back to the receiver tanks. These pipes are 4½ in. inside diameter and made of seamless tubing annealed and bent with radii of at least 12 in. so that the flow of oil is not subject to abrupt changes in direction, which would cause pressure rams.

All connections are made by means of flange joints. The piping opposed to the view above the main power house floor is of brass as well as all valves and fittings throughout the system.

Two auxiliary pressure tanks are connected to the ends of the supply pipe in order to prevent a serious drop of pressure due to the acceleration of the oil in the long supplypipe between pressure tanks and governor. The two main and the two auxiliary pressure tanks are interconnected by an air pipe and to an air compressor located in the basement which is driven by an electric motor. By means of this piping the air levels can be equalized between the various tanks or new air quickly supplied by starting up the air compressor.

Current is generated at 6600 volts and stepped up to 65,000 volts for transmission to Seattle.

The entire engineering work for this development was in charge of the Stone & Webster Engineering Corporation of Boston, the hydraulic equipment was built and installed by the Allis-Chalmers Company and the electrical apparatus by the General Electric Company.

GERMAN DEVELOPMENT OF THE HYDRAULIC RAM.

An interesting hydraulic plant was put in operation at Hull-an-Oste in the district of Stade in October last, a plant operated by the ebbing and flowing of the tide, the purpose of which is to drain about 1,360 acres of marsh lands which lie 2½ to 3 ft. below sea level.

By means of a device denominated the hydropulsor, the flowing tide against which the shore line at Hull is protected by dikes, passes through a mechanism which, being set in motion, lifts an equal volume of landlocked water and delivers it in a reservoir, where it is impounded until the tide ebbs. At this point the hydropulsor automatically ceases to operate, and the accumulation of water in the reservoir drains out into the sea, the process repeating itself at an annual cost stated to be 75 cents per hectare (2.47 acres) as against $2 to $3 for the same drainage operations were they undertaken by steam power. These costs contemplate operation, interest, and amortization. The Prussian Minister of Agriculture was so interested in the initial enterprise at Hull that he procured $10,000 from the Government to assure the carrying out of the plan.

The construction of the plant at Hull was made possible by the development of the original invention of the "water ram" by Joseph Michel Montgolfier. Montgolfier's ram consisted of a tank to contain the power water, a conduit, two automatic valves, and a delivery conduit with delivery air vessel. The water, being let out of the tank, is bound to escape through the cut-off valve, whereby a gradual acceleration in the current takes place until the accelerating velocity causes the cut-off valve to close of itself. When the escape is suddenly stopped, the entire water mass being still in motion, the recoil produced is called the water hammer.

The original ram of Montgolfier was serviceable only for small volumes of water, as the repeated action of the water hammer strained the machine, and especially when the diameter of the valves exceeded 1½ inches. An improvement on Montgolfier's apparatus was brought out recently by Adolf Abraham, a German surveyor of public works, who instead of battering or hammering valves, provided a revolving valve that brings the power water in regular turns in connection with the discharge conduits. This device is called the hydropulsor. When the entering or power water has reached its utmost velocity of flow the revolving valve makes a turn, thus bringing the impulse of the power water to bear on the water standing in the discharge conduit, lifting it beyond its level and causing it to overflow at the orifice. Owing to the work thus performed the pressure at the intake subsides, thus causing the revolving valve to make another turn, whereupon the pressure water flows in a second time, accomplishing a new acceleration and a repetition of the former processes, which is renewed indefinitely.

It is claimed that the hydropulsor is capable of delivering the largest volumes of water, the only limits being those imposed by the manufacturers of machine parts.

DRAFTING ROOM PRACTICE

BY A. L. MENZIN.[1]

Before a possible structure existing in the brain of the designer can begin to take form as a concrete reality, it is necessary that this structure be clearly described in a language which the constructor can readily understand. Drafting is this particular language.

Every structure is built up of one or more materials of which the form, size, composition and location may vary. In the process of building the structure, various means and methods may be employed. For giving exact information relative to these particulars, a work language alone is not sufficient, since the form of objects other than the geometric figures can only be described in a pictorial way. Drafting, therefore, combines the feature of pictorial and word language in a specialized form to best serve the purpose for which it is intended.

In the commercial use of this language, the following aims should be kept in mind:

1. Utility and Clearness.
2. Speed of execution.
3. Neatness and uniformity.

The problems of how to best achieve these aims come under the scope of drafting room management, it being assumed, of course, that the designer and the draftsman have a sufficient knowledge of how the desired structure will be produced, of the tools and equipment available, the manner of erection, the skill of the men to be employed, the limitations as to size and weight for transportation, the rough handling which the materials will receive, and such other knowledge as is prerequisite to planning work, which will permit of effective and economical production. Some factors in drafting room management will be considered in this and other articles.

In most drafting rooms, the following kinds of drawings are made:

1. Sketches of minor details.
2. Preliminary drawings necessary in designing.
3. Inexpensive tracings, principally for preliminary work.
4. Pencil drawings on detail paper, to be traced with ink on tracing cloth.
5. Final tracings.

The best size of paper for sketches is letter size, which is $8\frac{1}{2}$ in. x 11 in., since the sketches are most often made to accompany letters or orders for materials. It is seldom considered desirable to make blue prints of these sketches and, when copies are required, they may be readily made in the following way: Lay underneath the pencil sketch one or more sheets of blank paper with carbon paper in between, and stretch a piece of tracing paper or thin letter paper over the sketch. Trace the latter with a pencil of medium hardness, such as a 2H. The pressure of the pencil will produce carbon copies on the blank paper underneath.

Where sketches are used to any extent, it is advisable to have forms printed, which include the name and address of the company and such other information as is desirable on all sketches. This will save the draftsman much time and will give the sketches a better appearance.

In the drafting room, when designing is done to any extent, many of the important features have to be worked out by cut and try methods. The eye is a most helpful guide in proportioning materials, and it is therefore not uncommon to hear a designer say he will lay out a drawing "to see how it looks." For this purpose a cheap, unglazed wrapping paper is very satisfactory. A way of keeping this paper conveniently at hand is to mount a roll of it together with the common frame and cutter on the right hand side of the drawing table just below the drawing board. The cutter should be supported on the bottom so the paper can be unrolled by drawing it across the board.

For working on this paper, a 2H pencil is suitable for fine lines and an ordinary No. 2 writing pencil or an HB drawing pencil is satisfactory for general work. The detailer will often save himself much time if he will sketch out the desired detail roughly on this paper, fill in the dimensions from hand books or other sources of information, and then work from this sketch.

Much of the work in the drafting room is for preliminary purposes. For instance, it is desired to draw plans for a power plant. Preliminary drawings are gotten out and blue prints sent to various parties for approval, suggestions or bids. After the details are decided upon the work of making the final drawings is begun. It is not usually desirable to make the preliminary drawings with ink on tracing cloth for penciled paper tracings can be made in less than half the time. Very satisfactory blue prints can be made from these paper tracings if the penciling is well done.

Ordinarily the drawing is worked out direct on the tracing paper for which purpose a 2H pencil is very satisfactory. Afterward the lines are traced and the lettering done with a softer pencil such as an HB. On tracing paper the work should be coarser and the lettering larger than on tracing cloth.

For the final drawings the work should be accurately laid out with fine pencil lines on a good quality of detail paper. The pencil should be as soft as is compatible with accurate work, for the harder the pencil the greater will be the labor required when erasing construction lines or making alterations. For the line work a 4H pencil answers very well, and for dimensioning and lettering a 2H pencil is preferable since it is easier to letter with a soft pencil than with a hard one. A good eraser for removing pencil lines from this paper is a Ruby Eberhard Faber No. 112. For cleaning the paper, a black sponge eraser is commonly used.

After the final drawings are made on detail paper they are traced with ink on a first quality tracing cloth.

[1] Mechanical Engineer, San Francisco.

There is no right or wrong side to tracing cloth, but there is a dull and a glossy side, both of which are commonly used and give good results. However, it seems preferable to use the dull side, since pencil work can be done upon it, which is desirable for making alterations or additions. When the drawing is very simple, it may be laid out direct on the cloth instead of on detail paper.

For cleaning a tracing and removing pencil lines a soft white H eraser is very satisfactory. A 2 H pencil is suitable for work on the dull side.

Ink will not adhere readily to tracing cloth unless the surface is first prepared by rubbing it with chalk, pumice powder, etc. The dealers sell preparations put up in tin shakers or pepper boxes. A box with a removable top is more convenient for the cloth necessary for rubbing in the powder may be kept within the box and cannot easily become misplaced. Electro silicon metal polish is put up in this way and is very satisfactory. A handy means for removing the excess powder and for general cleaning is a painter's round dusting brush.

Erasing ink from tracing cloth is an every day occurrence in the drafting room. The success with which this may be done is dependent principally on the kind of erasers used. If the ink has only been applied recently it may be readily removed with an Emerald Eberhard Faber eraser No. 111. If the ink is old a harder eraser such as a Dietzgen ink eraser No. 3361 will remove it very quickly without injuring the surface. After the ink is removed a little of the powder should be rubbed over the erased spots to prepare them for future inking. Erasers containing considerable grit, such as typewriter erasers, should never be used on tracing cloth for, unless great care is taken, a hole will easily be made in the cloth. When these erasers are used grit is rubbed into the cloth. This makes future inking with anything like clean lines impossible.

Ink may also be removed by first scraping off the surface with a knife blade held at right angles to the cloth and then removing the remainder with an emerald eraser. However, it is safer to use the knife only for removing the ends of lines which have overrun their limits. When erasing, the shield will be found almost indispensable.

Some draftsmen still use red ink for dimension lines on tracings because red lines print up much fainter than black lines. There are so many disadvantages to the use of red ink on tracings that it is not generally advisable to use it. Red ink is very difficult to erase and it does not print up on brown negatives. Besides, it requires more time to use two colors of ink than one. For the making of tracings a good quality of black waterproof ink, such as Higgins is the only ink necessary. Differences in intensity of lines can be obtained by making them of different thicknesses.

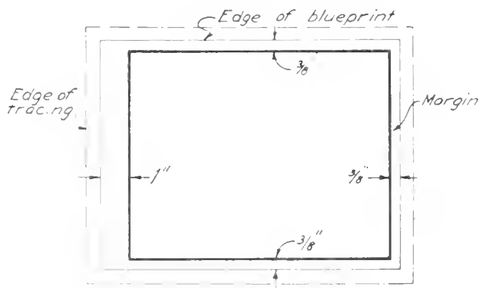
One of the first things to be decided, when a new drafting room is opened is what sizes of drawings shall be adopted as standard. Below are given measurements of blue prints, of approximately the same size, from representative firms in the United States:

Manufacturer	22 in. x 28 in.
Manufacturer	24 in. x 29½ in.
Manufacturer	24 in. x 36 in.
Operating Co.	26 in. x 34 in.
Operating Co.	26 in. x 40 in.
Manufacturer	27 in. x 39 in.
Manufacturer	27 in. x 36 in.
Manufacturer	27½ in. x 40 in.
Construction Co.	29 in. x 35 in.
Manufacturer	29½ in. x 41 in.

It will be seen that no two sizes are alike. From these and the measurement of many other blue prints, it would seem that no one size is more popular than another. This is to be deplored, for it is a disheartening task to take the blue prints which accumulate in the average drafting room and try to file them together in some orderly manner.

STANDARD SIZES OF DRAWINGS

Size	Service	Blueprint	Tracing	Margin
A	Reports	8½"x 11"	9"x 12"	⅜" & 1"
B		8½ x 22	9 x 23	do
C		11 x 17	12 x 18	do
D	Mach. Tools	17 x 22	18 x 23	do
E	General	22 x 34	23 x 36	do
F		34 x 44	36 x 45	do
G		44 x 68	45 x 69	do



No. A-732

Fig. 1. Standard Sizes of Drawings

The standard sizes of drawings adopted should permit of the economical use of tracing cloth and blue print paper; should be convenient for office, shop and field use; and should permit of rapid folding for mailing and filing. To fill these requirements the sizes of drawings given in Fig. 1 are suggested. By sizes of drawings is meant, of course, the sizes of blue prints.

It will be seen that the first size listed is 8½ in. x 11 in. which is exactly the size of letter paper now almost universally used. The other sizes are even multiples of this basic size. Hence every size will fold, by matching the edges, to 8½ in. x 11 in., which is a decided advantage for submitting with reports and specifications. For filing purposes, vertical filing cabinets and box letter files are in very common use and, as

these are designed for paper $8\frac{1}{2}$ in. x 11 in., drawings of the sizes specified may be filed with letters which they accompany, or may be filed separately in the same kind of filing devices.

Certain of the sizes listed are especially adapted for certain kinds of work. Fortunately, legal paper, which is $8\frac{1}{2}$ in. x 13 in., is going out of use for reports and specifications. These are often so lengthy that, when written on legal paper, they cannot be folded in the customary way, and how to file them becomes a problem since few offices have any use for the wide filing cabinets. For the purposes stated above, letter size paper is now used very extensively, permitting the documents to be filed without folding, which is a great advantage.

The size of drawing designated as A is especially useful for accompanying reports and specifications on letter size paper since it is of the same size as the typewritten sheets, and may be bound with them.

The draftsman should bear in mind that the person for whom a drawing is intended seldom has the conveniences for examining drawings that are to be found in the drafting room, and he should select a size accordingly. This is particularly desirable when the drawing includes work to be done by machine tools, for there is seldom any place available around a machine tool for spreading out a large blue print. For machine tool work the size designated as D is very convenient. In many shops it is customary to paste or otherwise fasten the prints to sheets of cardboard for convenient reference.

Size E is about the size used for general work. The tendency at the present time seems to be to use smaller drawings than heretofore. Instead of putting different details and views on one large sheet, it is better to put them on separate sheets of a convenient size.

Fig. 1 contains all the information which a draftsman needs to enable him to turn out drawings of the standard size. It is desirable, when standard sizes are adopted, to make a sheet similar to Fig. 1 and post it in a conspicuous place in the drafting room for ready reference.

The last two columns in Fig. 1 give the sizes of tracings and margins for all sizes of blue prints specified. The sizes of tracings and the margin, may, of course, be changed without detracting from the advantages of the specified sizes of blue prints. The margin should be as narrow as will look well so as to leave the maximum of space for the drawings. It will be noticed that the margin on the right hand side is much wider than the other margins. This is to provide for binding. The consulting engineer, the superintendent of construction, and the foreman in charge will find it very convenient to bind all drawings referring to a particular job, together.

By referring to the sizes of tracings it will be seen that all sizes with the exception of the last size may be cut without waste from 36 in. tracing cloth. Aside from the fact that there is no waste, the use of 36 in. tracing cloth is desirable in the interests of economy. It does not seem to be generally realized that the wider the tracing cloth, the more it costs per square yard. To show this the following table is given:

Approximate Cost of Imperial Tracing Cloth.

Width	Cost per linear yard	Cost per sq. yd.	Relative Cost.
30	$0.40	$0.48	1.067
36	0.45	0.45	1.00
38	0.55	0.475	1.055
42	0.60	0.514	1.142
48	0.80	0.60	1.333
54	0.85	0.567	1.26

The actual cost is somewhat less than the costs given above, but the relative cost is the same. It will be seen that 36 in. cloth is the cheapest, that 42 in. cloth costs 14.2 per cent more, and that 48 in. cloth costs 33 1/3 per cent more; 36 in. cloth should, therefore, be used when possible.

By comparing the sizes of tracings with the sizes of blue prints, it will be seen that there will be very little space outside of the blue print line for trying out pens. This is not a disadvantage as the detail paper usually extends out beyond the tracing and may be used for this purpose since it takes the ink very well.

It is generally desirable, to save time and waste of tracing cloth and blue print paper, to cut several sheets of the desired size at one time. These may be conveniently kept in metal or pasteboard tubes marked with the size, as shown in Fig. 2. The paste

Fig. 2. Method of Keeping Cut Tracing Cloth.

board tubes are very serviceable and inexpensive, and are suitable for tracing cloth, and tracing paper as well. For blue print paper the metal tubes are preferable.

It is not necessary that all sizes be kept on hand, as some will be used very rarely. Since one size, is exactly one-half of another, two sizes may be kept in one tube and only the size most frequently used need be kept on hand.

When certain sizes of drawings have been adopted, many firms designate each size by a letter and include the letter in the drawing number for convenience in filing the tracings. Thus, Fig. 1 bears the number A-732, which indicates that the drawing is number 732 of size A. A more inclusive method of numbering drawings will be discussed in a later article.

SUCCESS OF ELECTRIC IRON SMELTER.

The electric iron smelter at Heroult, California, is producing twelve to fourteen tons of high-quality pig iron daily, at costs averaging around $14 per ton. Two more furnaces will be installed immediately and within a year the company expects to be sending hundreds of tons of iron weekly to Coast markets.

The plant is at present consuming 2000 electrical horsepower per day and arrangements have been made whereby ample electric power will be constantly delivered. In addition to the commercial iron, it is also planned to produce chrome and other high-grade steels. Users of the iron already marketed pronounce it of exceptionally fine quality, and the industry is expected to revolutionize the employment of iron on the Pacific Coast.

WESTERN LAWS OF ELECTRICITY AND WATER

RIPARIAN RIGHTS IN THE WESTERN STATES

BY A. E. CHANDLER.

The modified rule of riparian rights has been followed by California, Kansas, Montana, Nebraska, North Dakota, Oklahoma, Oregon, South Dakota, Texas and Washington; and has been rejected by Arizona, Colorado, Idaho, Nevada, New Mexico, Utah and Wyoming. Its rejection by the above States was not due to constitutional or statutory provisions but to the fact that the doctrine was entirely unsuited to the physical conditions existing in an arid region, as shown by the quotations from Jones v. Adams and Coffin v. Left Hand Ditch Co., given in the previous article. Similar language was used by the courts of the other arid States abrogating the doctrine.

The only Supreme Court holding that the doctrine has been modified by statute is that of Nebraska. In Crawford v. Hathaway (67 Neb. 325) decided February 4, 1903, it is held:

The irrigation act of 1889 abrogated in this State the common law rule of riparian ownership in water, and substituted in lieu thereof the doctrine of prior appropriation. This legislation could not and did not have the effect of abolishing riparian rights which had already accrued, but only of preventing the acquisition of such rights in the future.

The Nebraska irrigation act of March 19, 1889, above referred to, was similar to the California statute of 1872 providing for the appropriation of water. This statute was considered at length in Lux v. Haggin—the latter party contending "that the Civil Code gives * * * a right to the water superior to that of the riparian proprietor below." Section 1422 of the Civil Code then contained the following words: "The rights of riparian proprietors are not affected by the provisions of this title." The court held that:

Section 1422 of the Civil Code is protective, not only of riparian rights existing when the Code was adopted, but also of the riparian rights of those who acquired a title to land from the State, after the adoption of the Code and before an appropriation of water in accordance with the Code provisions.

Neither a grantee of the United States nor the grantee of a private person, who was a riparian owner when the Code was adopted, need rely for protection on Section 1422 Such persons are protected by constitutional principles.

At the first legislative session (1887) after the decision of Lux v. Haggin, section 1422 was repealed with the proviso "that the repeal of this section shall not in any way interfere with any right already vested." This repeal opened the way for a new attack upon the riparian doctrine but no serious attempt has been made. If the California Supreme Court could be induced to accept the ruling of the Nebraska Supreme Court in Crawford v. Hathaway, the riparian right would be considered abrogated for all public land not entered in 1887.

The Congressional Desert Land Act of March 3, 1877, contains the following language in one of its provisos:

And all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes subject to existing rights * * *

This language was construed by the Supreme Court of Oregon in the recent case of Hough v. Porter (51 Ore. 318) decided January 5, 1909, as follows:

Construed, then, with the act of 1866 and other provisions of the act of 1877, we are of the opinion that all lands settled upon after the date of the latter act were accepted with the implied understanding that (except as to water for domestic purposes) the first to appropriate and use the water for the purpose specified in the act should have the superior right thereto.

Hough v. Porter was referred to by the United State Supreme Court in Boquillas Cattle Company v. Curtis (213 U. S. 339) decided April 19, 1909. The case involved a conflict between a riparian owner and an appropriator and the Court after stating that the riparian doctrine was not applicable in Arizona, continued:

The opinion that we have expressed makes it unnecessary to decide whether land in the arid regions patented after the act of March 3, 1877 * * * are not accepted subject to the rule that priority of appropriation gives priority of right by virtue of that act construed with Rev. Stat. 32339. The Supreme Court of Oregon has rendered a decision to that effect on plausible grounds

The Supreme Court of Washington, however, has refused to consider the Hough v. Porter rule sufficiently "plausible" to follow. In Still v. Palouse Irrigation & Power Co. (117 Pac. 466) decided August 19, 1911, the Court had before it a case somewhat similar to Miller & Lux v. Madera Canal Co., except that the defendant company attempting storage was also a riparian owner. The company contended for the rule laid down in Hough v. Porter, but the court held that "the act itself manifestly relates only to the reclamation of desert lands" and refused to apply the rule as the lands involved had not been entered under the Desert Land Act. As noted above the Oregon Supreme Court held that the rule applied to all public land, which should be the construction if the decision were rendered on "plausible grounds." The Supreme Courts of California, Montana, North Dakota and South Dakota (the remaining riparian right States to which the Desert Land Act applies) have not as yet been asked to accept the rule of Hough v. Porter and their position is therefore still doubtful.

Lateral Limits.

It has been shown in the previous article that an appropriator can neither divert nor store flood waters when such might result in damage, present or prospective, to a riparian owner. Any large project, to protect itself, must therefore purchase the riparian land or the riparian right annexed thereto—it being well settled that the riparian right may be sold apart from the land.

The generally accepted lateral limit of riparian land is the margin of the water shed. The Supreme Court of Oregon, however, in Jones v. Conn (39 Ore. 30) has held that riparian lands are not so limited but extend to the exterior boundaries of the watershed. It is the only State wherein a riparian owner, under the claim of riparian right, may divert the water of a stream beyond its watershed. The general rule is based on the idea that only those lands which border on and drain into a stream can be considered riparian thereto.

In two cases the California Supreme Court has materially restricted the lateral limits as shown by the following quotations.

> In the case at bar the stipulation is that these fourteen quarter sections were granted each by a separate patent, each patent being based upon a separate entry, and these fourteen quarter sections therefore constitute fourteen distinct tracts of land, and mere contiguity cannot extend a riparian right which is appurtenant to one quarter section to another, though both are now owned by the same person. *Boehmer v. Big Rock Irr. Dist.*, 117 Cal. 27.

> If the owner of a tract abutting on a stream conveys to another a part of the land not contiguous to the stream, he thereby cuts off the part so conveyed from all participation in the use of the stream and from riparian rights therein, unless the conveyance declares the contrary. Land thus conveyed and severed from the stream can never regain the riparian right, although it may thereafter be reconveyed to the person who owns the part abutting on the stream, so that the two tracts are again held in one ownership. *Anaheim Union Water Co. v. Fuller*, 150 Cal. 331.

As later decisions have not modified the above rulings, they may be considered accepted in California. The Nebraska Supreme Court in Crawford v. Hathaway considered this question at great length and concluded:

> A riparian owner's right to the reasonable use of water exists solely by virtue of his ownership of the lands over or by which the stream flows. It is obvious that his right cannot be enlarged or extended by acquisition of title to lands contiguous to the riparian land, nor can a riparian owner, as such, rightfully divert to non-riparian lands water which he has a right to use on riparian land, but which he does not so use.
> It being the policy of the government to dispose of its public domain in tracts of not less than 40 acres each, why, then, may it not be said that riparian rights are limited to such tracts, even though several of them may be joined together in one certificate of purchase or instrument of conveyance? It is not decided that such should be the rule in this State, as it is deemed preferable to leave the question open for maturer investigation and consideration.

The Supreme Court of Texas in Watkins Land Co. v. Clements (86 S. W. 733) decided April 24, 1905, held that riparian rights "cannot extend beyond the original survey as granted by the government."

Were it not for the recent cases wherein lower riparian owners (on a showing of possible damage) have been allowed to stop the storage of flood waters by either riparian owners or appropriators, those interested only in power development might be strongly in favor of the riparian doctrine. Under it they can demand that the waters be allowed to flow to even the mouth of the stream if a power site there existed. Such lower sites, however, are exceptional, and as most power developments necessitate storage, prospective power plants are as materially affected by the flood water decisions as irrigation projects. If the riparian doctrine must continue in force in so many western States, some relief can be secured by inducing the courts to further restrict the lateral limits. A general acceptance of the suggestion of the Nebraska Supreme Court that riparian rights be limited to forty acre tracts would lessen the difficulties in the way of the newer and larger projects.

The forty acre suggestion applies, of course, to public lands only. In California there are a great number of large Spanish grants, each of which must be considered a single parcel, and to such the suggestion would not apply. As those grants often extend from watershed to watershed, they contain large areas riparian to streams crossing them. While such a grant remains in a single ownership, the proprietor thereof, under the decisions cited, practically controls the streams as far as appropriators are concerned.

In the quotation from Anaheim Union Water Company v. Fuller, above, it is stated that in a partition of a riparian tract the part distant from the stream loses its riparian right "Unless the conveyance declares the contrary." A number of Spanish grants crossed by streams are now being subdivided, and the deeds are so drawn that the various parcels share in the riparian right, regardless of proximity to the stream. It is well settled that the parcels so conveyed retain the riparian right among themselves, but the western courts have not yet directly passed upon the question as to whether the owner of such a parcel not touching the stream can be considered to possess a riparian right as against an appropriator or riparian owner outside the original grant. Mr. Wiel, in the third edition of his splendid work on "Water Rights in the Western States," raises this question and after an exhaustive study of the cases bearing on the point, concludes that such parcels not bordering upon the stream cannot be considered riparian when in conflict with rights outside of the grant. The conclusion is certainly based on sound reasoning and conforms to the basic idea that only lands bordering upon a stream are riparian thereto. This question will undoubtedly be raised in the near future and the hope of all appropriators is that the courts will accept Mr. Wiel's conclusion.

In those instances where the land along the stream below a reservoir site was secured under the public land laws, the maximum limits of riparian lands (in California, Nebraska and Texas—the public lands in the last being State lands only) may be determined by an examination of the land office records, as only those forties which touch the stream or were included with such forties in the original patent can be considered riparian. Where the stream passes through lands which were part of a Spanish grant in California, abstracts of title must be examined in order to ascertain the least parcel touching the stream at one time in a single ownership. In the riparian States, other than California, Nebraska and Texas, the ordinary assessor's map showing ownership along the streams will give the riparian lands—they being those tracts in single ownership not extending beyond the watershed. The last statement must be modified for

Oregon, as there the riparian land is not limited to the watershed.

Riparian Right Restricted to Riparian Land.

On account of the riparian right being so superior (in the riparian right States) to that of appropriation, there is a popular idea that a riparian proprietor actually owns the water and is not limited to its use on his riparian land. The courts, however, have consistently held to the contrary, as illustrated by the second quotation from Crawford v. Hathaway above. Of the many cases thus holding, one presenting unusual conditions is Duckworth v. Watsonville Water & Light Company, (150 Cal. 520).

The Watsonville Company, in order to protect its diversion of the waters of Pinto Lake to Watsonville, had purchased either the riparian land or the riparian right for all the lands bordering on the lake. Duckworth leased a parcel of such riparian land, posted a notice of appropriation, initiated his diversion work and brought an action to have his water right determined as against the company. The company claimed that by the purchase of the riparian lands and the riparian rights, including those annexed to the parcel occupied by Duckworth, it was entitled to all of the waters of the lake. The following extract from the opinion, clearly presents the court's view:

We have said that the water company is entitled to a judgment protecting its riparian right, although it has not used, and does not immediately propose to use, the water on its riparian land. This rule does not apply to any right which it has acquired by appropriation or use upon other lands, and this appears to be the source of the right which it has been exercising. Such right depends upon use and ceases with disuse (Civ. Code, 1411). It extends only to the water actually taken and used. The consequence is that, so far as the protection of this right and the water necessary to supply this use are concerned, the water company is not entitled to prevent an appropriation or use by others of the surplus of waters of the lake, if there is any.

In the last article attention was called to language used by the Nevada Supreme Court in Van Sickle v. Haines, and by the California Supreme Court in Lux v. Haggin, which characterized the doctrine of appropriation as one certain to result in monopoly. The passage quoted immediately above tells another story.

Summary of Principles.

The riparian doctrine has been abrogated in the seven strictly arid States and has been adopted in the ten semi-humid States of the irrigation zone. Of the ten, it has been held in Nebraska that the State water appropriation act annulled the riparian rights for public lands then unentered, and in Oregon that the congressional desert land act did likewise.

The doctrine restricts the right to riparian lands and allows a reasonable use of water to all riparian owners, the measure of which will depend upon the conditions of the particular case. The right is not created by use and does not cease with disuse. As between a riparian owner and an appropriator, the former is not limited by any measure of reasonableness, and may restrain any diversion or interference with the flow (including flood waters) by the latter which may result in damage to his riparian land.

Except in Oregon, riparian lands are limited to the watershed. In California, Nebraska and Texas the right is further limited to the original tract granted by the government, and in California still further limited to the smallest tract at one time in a single ownership.

It is improbable that the lateral limits may be ultimately limited in some States to the forty acre tract crossed by the stream, and that other States may follow Nebraska and Oregon in their construction of State and federal statutes. It is certain, however, that statutes annulling riparian rights existing prior to their passage are clearly unconstitutional. All such changes in the doctrine must be made by the courts and not the legislatures.

INTERNATIONAL TECHNICAL COMMITTEE'S REPORT ON WESTON NORMAL CELL VALUE.

A report to the International Committee on Electrical Units and Standards by a special technical committee appointed to investigate and report on the concrete standards of the international electrical units and to recommend a value for the Weston Normal Cell has been prepared under the supervision of Dr. S. W. Stratton, director of the Bureau of Standards, Department of Commerce and Labor.

The conclusions and recommendations are contained in the following resolutions:

(1) The committee decides to choose as the value of the Weston Normal Cell the mean value of the cells presented by the delegates of the four laboratories. This mean was determined in the following way: There was first determined the mean value of the normal cells presented by each delegate, then the mean was taken of the four numbers thus found.

(2) The committee decides to choose, for the present and until there are other mercury ohms prepared, as the value of the international ohm, to be recommended to all countries for general use, the mean of the values of the units realized at the Physikalisch-Technische Reichsanstalt and at the National Physical Laboratory. Although the international ohm as defined by the London Conference has not yet been strictly realized, the committee believes that its value has been attained in two laboratories independently with a good degree of precision, and that future work is not likely to change it by more than 2 or 3 parts in 100,000.

(3) In view of the fact that the mean of the results with the silver voltmeter obtained by this committee will probably not be changed by more than a few parts in 100,000 when the specifications are finally completed, the committee decides to recommend to the International Committee on Electrical Units and Standards the following value for the electromotive force of the Weston Normal Cell:

$E = 1.0183$ international volts at 20° C.

On the subject of the standard cells, the committee is of the opinion that new experiments are necessary before completing or changing the specifications of the London conference.

On the subject of the ohm, the committee expresses the hope that new international ohms, fulfilling all the specifications of the London conference, may be realized soon in different laboratories.

On the subject of silver voltameter, the committee is of the opinion that the specifications for the silver voltameter should not be completed until further experiments shall be made by the members of the committee in their respective laboratories on subjects which are not considered settled at the present time, and that after these experiments the committee shall complete the general specifications.

THE ACCOUNTANT IN PUBLIC SERVICE CORPORATIONS.

BY N. I. GARRISON.[1]

The accountant in public service corporations occupies a place of no mean responsibility. His duties involve matters of the greatest importance to the company. He records its transactions and determines from their character what accounts they effect. The two general divisions of corporations accounts embrace on the one side its assets and on the other its liabilities. The assets are divided into corporeal or physical assets and incorporeal or intangible assets. The rules which govern entries into the physical asset account are practically well defined and clear and will not be considered in this connection. Many of the intangible asset accounts are so closely related to the operating account that it is often difficult to determine the line of separation.

Some of the causes for certain disbursements afford debatable questions as to whether the charges should be distributed to capital or to operating account. The showing of the earnings of a company is lessened or increased accordingly as these charges are made against the one account or against the other.

As it is the business of the accountant to solve these problems of distribution it is evident, that as stated in the outset, his duties involve some responsibility.

It is the object of this discussion to consider these intangible asset accounts in the light of such transactions as furnish appropriate examples, and to prescribe some determinate rule for distributing them, and to place upon them such distinctive marks as may distinguish them from the operating account.

To this end we shall assume that A and B are two corporations, each possessed of a capital of $1,000,000. A invested his capital in an established electric light and railway business in a town of a considerable size, in a densely populated community. B took his capital into a sparsely settled country and there, in a smaller town, purchased a railway and lighting plant, and by improving its possibilities, he so increased its earnings and capitalization that, in the course of time, he developed it into exactly the same condition as was A's plant at the time A acquired it.

From the transactions of A, who acquired a property already organized and established and doing business as a going concern we hope to learn, in a general way, the nature of some of the items which represent the intangible assets of a corporation.

B purchased a plant, doing comparatively a small business. By observing his operations in the development of this small business up to the volume of A's property we shall have occasion to notice some of the purposes for which expenditures are made and the reasons for which they are distributed into the intangible assets accounts.

When A took over his property it was capitalized for $1,000,000 and was earning a fair income on that amount. It owned physical property of the value of $600,000, the balance of $400,000 consisting of intangible assets—not being represented by any corporeal property. We assume A to be possessed of competent business ability and that his investigation of the affairs of the company, before buying, established its worth, as a going concern, to be at least $1,000,000 according to the ordinary business standard of valuations in similar cases. We also assume that he found that the $400,000 of intangible assets had been embraced in the capitalization of the company by approved and legitimate methods of accounting.

If we can analyze this asset account in such a way as to ascertain the reasons which justified A in acquiring it for a valuable consideration, we shall learn something of a class of accounts which is often perplexing to the accountant in the public service corporations.

The conditions which A investigated in arriving at his estimate of the value of the property, involve some of the items which enter into these accounts. In his examination of the plant as a prospective buyer he found that the car barns and shops were located in the central part of the town, from which radiated the various lines of the system. The appraised value of the barns and shops was $30,000, although by applying the ratio of the purchase price to the physical value, he found that they would cost $50,000. A plot of ground of the size occupied by the barns could be bought at the outer terminus of the system and the buildings and machinery duplicated for $30,000, or for $20,000 less than their capitalized value. In considering the new location it was calculated that the additional cost of car maintenance and operation from the distant point was more than a fair earning on the increased cost of the central location.

He accordingly concluded that it would be better to capitalize for $20,000 more, in order to secure the advantages of a more economical and convenient base of operation. In other words it was found feasible to capitalize a location for $20,000. A certain piece of track in the center of the business district, held at $100,000, could be duplicated in the suburbs for $60,000. The passenger receipts in the business district were more than the receipts from the same length of track in the suburbs, by a sum greater than a fair income on the $40,000 difference in cost; from which he decided to capitalize for this additional amount and secure the advantages of the down-town condition; or in effect, he capitalized a condition at $40,000.

He reasoned that the location on the one hand and the condition on the other, when considered as an element in the earning capacity of the property, were just as much assets for the purpose of capitalization, as the physical property itself.

An examination of the other branches of the business disclosed the nature of the balance of the intangible assets. They consisted, in some instances, of advantageous locations and conditions, of patent rights, privileges, franchises, leases, rights-of-way, easements and such like appurtenances, which, when considered apart from their connection with the physical property, were entirely worthless, but being regarded as an essential element in the earning capacity of the plant, their value as an earning power, in some cases, far exceeded that of the physical equipment of equal cost.

[1] Auditor of the Ft. Smith Light & Traction Company, Ft. Smith, Ark.

Wherefore, A concluded that these intangible assets, by reason of their being an important and material factor in the earning capacity of the property, were proper and legitimate subjects for capitalization.

This examination of A's property has given us some idea of the general nature of the asset amounts under consideration, but it has not furnished any specific and typical examples of distributions such as might be used as a guide in the creation of these accounts.

For an observation of those transactions that furnish examples of distributions which are debatable as to whether they properly belong in the capital or operating account, we shall now consider some of the operations of B.

He bought a well equipped and modern plant for $500,000, all of which was represented by physical assets, and which was earning a fair income on that amount and no more. The remaining $400,000 of his $1,000,000 capital was reserved and afterwards used in the development of his property and distributed into intangible asset accounts, no part of this sum being used for physical improvements.

B found that the plant had been operated by an indifferent management and that its records had been loosely kept and were indefinite, and that its operation had been without system and wasteful. He reformed the accounting and introduced system and economy into the operation, thereby increasing the earnings to an adequate income on $700,000 instead of on $600,000. He took advantage of this improved condition and capitalized the $100,000 increased earning capacity. As no outlay of capital nor other factor had entered into this increased earning power, except B's ability, it may be fairly said that B capitalized his brains at $100,000.

While it is probably not an uncommon occurrence, by indirection, to capitalize brains, it can hardly be regarded a wise and safe practice to capitalize indiscriminately, the creative brains of a man who may die tomorrow and cause to fail the asset upon which the capitalization was based. However, if the business ingenuity of a man causes the inauguration of such economic systems and reforms as will cause a property, in its original condition, without additional improvements, to yield an increased profit, and these reforms be of such a nature that of their own merit, they will, in all human probability, perpetuate the additional capacity; then in that case, the cause of such increased capacity may be a proper asset for capitalization; and in this sense, it may be said that a man's brains are a suitable basis for capitalization, but not otherwise.

B organized a New Business Department and engaged solicitors to procure additional customers, and incurred much expense in demonstrations and trial installations of apparatus, and thereby further increased his income, without adding to the physical property. He kept records of the expenditures of this department and of the net profit on the business it secured. He canvassed his territory and recanvassed it, and continued until he had spent $10,000 when the diminishing returns fell below a justifiable profit on the outlay.

Up to this point the new business which he had secured was of the same general permanent character and yielded the same rate of income as the property had previously earned. In acquiring the original plant he had calculated its value to be that amount on which its income paid a reasonable profit; or, in other words, he based the value of the plant, as a going concern, on its capacity to earn. By similar reasoning he based the value of the New Business Department on its capacity to earn. As already stated the income on the new and permanent business secured by this department was the usual income on $10,000, which was the amount of its cost. B accordingly charged this expenditure into capital account.

All of the available business having been secured, and B observing that the output capacity of his plant was still greater than the demands and requirements of the population which it served, began to cast about for ways and means for enlarging the field for his operations. To this end he caused a commercial league to be organized among the business men of the town and he contributed a bonus and advertising fund for the acquiring of shops and factories.

Through effective advertising and bonuses, judiciously placed, industries were secured which used his power and employed laborers who consumed his current and rode his cars.

An electric and railway plant in a town of 10,000 inhabitants has a value limited by this patronage notwithstanding its output capacity may far exceed this demand. The same plant in a town of 15,000 population has a greater value, for the reason that its opportunities to earn are greater.

B advocated, and procured the establishment of improvement districts and their boards levied taxes against his property for the construction of sewers and the paving of streets. He regarded these improvements as an addition to the value of his plant and accordingly covered the taxes by his investment accounts.

In the course of time B found that these and similar expenditures had exhausted his $400,000 reserve without adding any physical improvement to his plant. He also found that he had increased its earning capacity to a fair income on $1,000,000 and he capitalized for that amount. He now had a capitalization of $1,000,000, represented by a physical property of $600,000 and an intangible asset of $400,000, which was the exact condition of A's concern, which we first considered.

If the foregoing examples are practical and the reasoning sound, then we conclude that the proper tests to be applied to the disbursements, to determine whether they are proper charges against intangible asset accounts, as concisely as we can state, are in effect and substance as follows:

That every expenditure that either directly or indirectly increases the earning capacity of a corporation, in a way that is stable, permanent and commensurate with an adequate income on the outlay, is properly, justifiably and legitimately a charge against capital account. These, we believe, are the distinguishing marks and this we conceive to be the general rule.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

The West as World Beaters in Engineering

It has been well said that the "race is to the swift." Our hydroelectric enterprises, having their incipiency a score of years ago in the modest little power plant of San Antonio canyon in Southern California, startled the world at that time by daring to even hope to transmit electrical energy at ten thousand volts into San Bernardino, twenty miles eastward. It is inconceivable to believe that even the promoters of this original undertaking could have dreamed the world-wide proportions to which the child of their imagination would grow upon its reaching the years of manhood.

It is interesting to recite some of the world-beating engineering achievements which have been accomplished in the West since this epoch-making period has been with us.

A corporation in its endeavors to transmit into San Francisco hydroelectric power generated in the high Sierras of California encountered the waters of the great San Joaquin and Sacramento rivers. Being navigable streams, the only feasible manner of getting power across them without submarine cables was by an overhead steel span of 4 separate wires, each 4600 ft. long and 150 ft. above the waters of Carquinez Straits. This feat is unique and unequalled today. Another company in its endeavors to supply Oakland and San Francisco with similarly generated hydroelectric power has just completed a submarine cable crossing under San Francisco bay, which for a working pressure of 12,000 volts of submarine transmission over an 18,800 ft. length cable and other features encountered in crossing under navigable waters, is equally remarkable.

San Diego, the enterprising city of the extreme southwest, in its endeavors to assure its municipal water supply, even over a series of dryest years ever to be anticipated, has just completed the Morena rock-fill dam which is 267 ft. high from foundation to the top, constituting the highest dam of its kind in the world. The citizens of Los Angeles, in synchronism with the balmy stimulating atmosphere surrounding them, are just completing the greatest municipal undertaking in the world—the Los Angeles Aqueduct. Pure mountain water is being brought a distance of 250 miles in sufficient quantity to supply a city of 2,000,000 inhabitants. The physical features met with and overcome constitute the most remarkable achievement ever accomplished under municipal guidance.

In Idaho, a State of unusual promise in development of arid land reclamation, the Minidoka Project presents another record in combination of gravity and hydroelectric reclamation. Here the U. S. Reclamation Service has in operation the largest pumping station that has been undertaken. Water is pumped for approximately 48,000 acres, the average lift being 66 ft.

The Roosevelt dam of Arizona brings its abundance of wealth to a newly-admitted State comprising a project exceeded by only one other in the world.

Under this project, 16,320 acres of land are submerged, thereby impounding 1,284,000 acre-feet of water. The dam is 1080 ft. long on top and 280 ft. high; 332,300 cu. yds. of material were necessary in its construction, its cost being $3,470,000.

The City of San Francisco swept from the face of the earth by the greatest municipal conflagration of history, today beams and smiles with its wonderful masses of steel and concrete, a fitting emblem of the brave people it represents, and today with its high pressure fire protective system, marks another epoch in municipal accomplishment.

The City of Seattle is now being supplied by power generated by recently installed hydraulic turbines of 20,000 h.p. capacity, described on another page, which again add another laurel to our triumphant West. The Big Creek enterprise of the Pacific Light & Power Company, now actually under construction, constituting a hydroelectric system, which will ultimately transmit into Los Angeles 120,000 kw. of electrical energy at 120,000 volts with two steel transmission towers each supporting six wires stretching 275 miles in length, gives an idea of the projects preparing for 1915. These projects will, in a measure, be fitting accomplishments to offer for inspection to our engineering brothers from all over the world who come to celebrate the greatest of all achievements, the digging of the Panama Canal.

Indeed, the race is to the swift, and, in the race ahead, the West—like the breathless negro when the overtaking ghost commented upon the swift running feat the negro had just performed—has but one remark to make: "Just you wait ah minute, boss, till I kitch mah breath—and den you'll see ah real race."

Capitalization of Brains

The fisherman is the only engineer, known to modern science, who makes his receipts all net. The rest of us must continually cast about for new ideas. When they are finally entangled and brought ashore, even at best, skillful application is necessary to convert the idea into an entry on the positive side of the ledger.

The successful engineer of the day is permeated with constructive imagination. Figuratively speaking, in such a masterly mind, the useful but fleeting thoughts, straying across the magnetized mental tissue, are drawn into consciousness in the shape of full blown practical ideas as surely as the iron filings are drawn from the sands along the sea-shore when the child passes a horse-shoe magnet through the playful house-fantasies it constructs near the great ocean waves.

Such a mind does not present to his superior or to the world some half-baked idea, which needs only to be pricked in a vital spot to send it to a premature death. A truly practical idea is immortal. It cannot die, though in the thundering advance of the electrical industry it may, perforce, in a season, be relegated to the junk pile. Even if this should prove to be its untimely fate, yet, as each individual link binds the completed chain, without its being brought into existence, the advance of an industry would have been crippled or impossible.

Not alone is this true in the matter of invention in physical machinery, but in the working out of the details and organization of the present day public service corporation, the brains of their constructive leaders as truly portray the divine elements of invention and genius as does the wizard in his physical laboratory.

No regulation of a corporation which causes stagnation in its progress will ever be for the good of our nation. Nor will any regulation which seeks to dull advance in efficiency and economy in the supplying of our great public necessities, aid in the working out of national betterment.

Like the god-given love of woman for man, genius is a delicate, fleeting phantom which without constant nurture cannot exist as a reality in the human make-up.

The master-mind of a corporation that in one fell stroke dreams of municipal greatness and then spends working capital in accomplishing that greatness unquestionably creates an intangible asset for his corporation, which should be credited to its account as truly as the most lasting physical reality upon the inventory. The phenomenal growth of Western greatness is largely due to the foresightedness and genius of the leaders in development of hydroelectric enterprises and its myriads of kindred industries.

The whirlwind campaign for municipal growth in inviting and subsidizing new manufacturies to enter a municipality, the issuing of bonds for school and civic bettermen, have in many cases been due to the push and energy of these genii of industry and the ledgers of many corporations show large expenditures in their behalf. The details of the duties of the accountant in public service corporations by N. I. Garrison, appearing on another page, is fascinating and instructive in illustrating this point.

It would seem that a more carefully compiled policy on the part of our public service commissions should be drawn up to protect the advance of new ideas in corporation management, the promotion of increased efficiencies and economies in power generation and above all else the encouragement of the bringing to consciousness in the brains of our corporation genii, a continuation of the train of inventive ideas which have operated for good, in our modern efficient mechanisms in the production of living necessities—heat, light, water and transportation.

It is a pity that practically all human endeavor is largely brought forth under hounding pangs of hunger or the longing for material wealth, but since such is the case, the only practical method of encouragement for such effort is a reasonable capitalization of the brains employed in the upbuilding of the modern public service corporation fabric.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, is at Fresno and Los Angeles.

A. M. Hunt recently returned to San Francisco after a long vacation spent abroad, principally in Egypt.

John S. Eastwood recently returned to San Francisco after visiting Los Angeles on engineering business.

O. E. Stanley, consulting engineer at Portland, has been investigating a power proposition at Sheridan, Ore.

E. G. Williams, the manager of construction work for J. G. White & Company, has arrived at San Francisco from New York and is visiting his firm's local office.

James C. Wallace, who is connected with the construction department of the Stone & Webster Company in California, spent several days at San Francisco during the past week.

H. W. Clapp, chief assistant electrical engineer of the Southern Pacific Company's electric roads, recently made an inspection of the company's lines along the peninsula south of San Francisco.

H. L. Jackman, manager of the Western States Gas & Electric Company at Eureka, Cal., has been appointed a member of the Eureka Industrial Commission, which is inducing manufacturers to establish plants in Eureka.

H. S. Carhart, formerly professor of physics at the University of Michigan and now retired on a Carnegie pension, is now connected with the Throop Polytechnic Institute at Pasadena, where he has a special electrical research laboratory.

Robert Sibley has been appointed by the Regents of the University of California as head of the department of mechanical engineering at the State University. Mr. Sibley will continue his duties as chief editor of the Journal of Electricity, Power and Gas.

C. W. McMicken, superintendent of the Croesus Gold Mining & Milling Company, is at San Francisco for the purpose of purchasing electrical supplies for use in connection with the electrical installation operated in connection with the company's mines in Sierra County near Allegheny, Cal.

Wynn Meredith, of Sanderson & Porter's San Francisco office, has received advices to the effect that the Willapa Harbor Railway Company's new electric railway, owned by the above firm, inaugurated its regular service between Raymond and South Bend during the past week. The first trip between the two cities was made in about sixteen minutes.

The following engineers were guests at the recent banquet in San Francisco, given by the Associated Electrical & Mechanical Engineers of the University of California: C. E. Grunsky, E. C. Jones, A. E. Chandler, James H. Wise, Alexander McAdie, George J. Henry Jr., H. F. Fischer, C. W. Whitney and A. B. Domonoske. Robert Sibley acted as toastmaster.

Gano Dunn, president of the American Institute of Electrical Engineers, and Ralph W. Pope, honorary secretary, were the guests of the Los Angeles Section at a dinner at the Hotel Hollenbeck on April 11. James M. Gaylord presented a paper on "The Mechanical and Electrical Work of the Reclamation Service." Messrs. Dunn and Pope will be the guests of the San Francisco Section at dinner on April 13 and then proceed to Portland to preside at the Pacific Coast Convention, April 16 to 20.

One of the largest engineering classes in its history will be gradauted at Stanford University next month. The candidates for diplomas in the civil engineering department number thirty. Those in the electrical engineering department are: Edward N. Adam, John J. Argabrite, Ralph Raymond Beal, Thornton Easler, Herman Endres, Andrew James Field, Jarrett Townsend Lake, Sisag Vahran Melcon, Zenope Parnak Melcon, Homer Alfred Mullen, Herbert E. Pelton, Herbert Raines, Ralph Leonard Robinson, Sidney Burton Shaw, Morris Wenk.

Members of a commission of officers of the Norwegian Telegraphs and Telephones arrived at San Francisco during the past week and thoroughly inspected the two local telephone systems. The commissioners, who have covered the greater portions of Europe and America, are S. R. Abild, engineer in chief; L. Iverson, director of telephone and telegraph administration; G. Engset, commercial manager, and Einar A. Brofos, an electrical engineer of Chicago. After visiting the Pacific Northwest and British Columbia the commission will try to determine which type of American telephone systems would be the best to adopt in place of the one at present used in connection with the Norwegian Government telephone lines.

ELECTRICAL DEVELOPMENT LEAGUE.

Tuesday, April 9th, at Tait's Cafe, another record breaking attendance was experienced for the Electrical Development League in San Francisco. G. C. Holberton at the close of the luncheon called upon W. W. Briggs, chairman of the entertainment committee to make good. Mr. Briggs, in his usual happy, smiling manner, then introduced R. M. Searle, vice-president and general manager of the Rochester Railway & Light Company, who in a pleasing and interesting style, held the close attention of the hundred members for a half hour talk on the electrical art and its possibilities.

Mr. Searle began his career in the electrical industry as an office boy for T. A. Edison in 1883. He informed the men present that eastern bankers, upon learning of his intended trip to California, had requested him to make a report on electrical securities and their reason for existence in the West. "I shall tell them," said Mr. Searle, "that the invention of Burbank, the spineless castus, is the only product in this section of our country with that physical deformity." Continuing, the speaker said that he considered the electrical industry of California developed only 35 per cent at present, and that with bank clearings for the past month of $212,000,000 as opposed to $183,000,000 the previous year, together with 25 per cent increase in building permits now totaling $2,700,000 per month, San Francisco and its district had a brilliant future before it.

The speaker then touched upon the new inventions now soon to be placed upon the market in which immense increases in electric power consumption may be reasonably looked forward to. The thermostatic bed-warmer, making porch sleeping possible; the electric hot water heater, at one-half cent per off-peak current, comparable to coal at $8 per ton; and especially the Stanley stove, which by means of 3 cast iron heating units, each requiring 100 watts continuous consumption, a revolution in cooking stoves may be anticipated. Electric ventilators and ozonators, together with trolleys for electric trucks in congested cities, he prophesied would soon consume enormous electrical outputs. "I like to see a dollar turn over," declared the speaker, "for it means twenty more dollars will be added to it before it stops rolling."

The immense possibilities of iron production from the great natural ore deposits in Northern California were declared to be a great future for electrical consumption in this State, as well as adding greatly to its natural resources.

Electric processes in the manufacture of nitrogenous fertilizers were also dwelt upon very interestingly. "In conclusion," said Mr. Searle, "boost the electrical game. Don't be slow. We have a man in Rochester who is so slow it is related that he was once run over by a stationary engine. Finally, if I have said anything here, I am sorry for I am glad of it, for I am earnest in my endeavors to develop the best in all affairs electrical."

ELECTRICAL CONTRACTORS' NOTES.

The Electrical Contractors' Association will be the guests at dinner Friday, April 12th, of the Pacific Gas and Electric Company. The object of the dinner is to help the contractors and central station managers to get better acquainted, as was suggested by the Power Companies Committee of the California State Association at its last meeting.

The Electrical Contractors' Association sub-committee met with President McCarty of the State Building Trades Association to talk over an agreement to create harmony and good trade conditions through the fair period, between contractors and their employees.

W. S. Hanbridge was in San Jose Wednesday arranging with the convention committee to get things started. The San Jose boys promise a large time and hope to have all the electrical men in the State with them in August. Statesman Sanderson has placed himself on record to pull off a large rejuvenation at San Jose in August. Frank Somers will look after the hotels; John Guilbert, electric trades day; Chas. Fuser, railroad fares; R. E. Warren, entertainment. Committees from San Francisco will assist the above gentlemen in taking care of the visitors. There will be a good time for all and among the attractions planned are a dance, sightseeing trips, the annual dinner, a Sons of Jove rejuvenation, and on the last day an electrical trades day picnic, which promises to be the best ever held.

Newberry & Benheim have been awarded the wiring for the Standard Oil Building.

The Pacific Fire Extinguishing Company have been awarded the contract for wiring Hale Bros.' new store.

Chief Nixon of the Department of Electricity issued the following rule:

March 30, 1912.

To all concerned:

Feed Wiring for Apartments and Flats.

Not more than one set of feed wires will be permitted in any one circuit. Where circuits are run from apartments or flats to meter location, same will be considered as feeds.

This rule is made to do away with the possibility of having a.c. and d.c., or two separate services, in any one conduit.

WM. J. NIXON,
Chief, Department of Electricity.

TRADE NOTES.

The General Electric Company has recently completed negotiations for taking over the entire Holophane organization, consisting of both sales and manufacturing departments. The Fostoria Glass Specialty Company will be united with the Holophane organization, probably in the forms of a new company. The sales and engineering parts of the business will be directly under the charge of Mr. V. R. Lansingh, while the manufacturing will be under the charge of Mr. E. O. Cross.

On March 25th to 29th, inclusive, the sales agents of the Fort Wayne Electric Works of the General Electric Company were assembled in convention at the home office at Fort Wayne, Ind. There were about seventy-five of the salesmen, including the managers of all the district offices of the company present at the various sessions. The sessions were held in the assembly room of the fine new factory building No. 17 which is now nearing completion. The business of the convention was given over largely to illustrated lectures and discussions covering the commercial, and as well, the manufacturing side of all the company's product. On Wednesday evening of the convention there was held at the Elks' Temple a banquet and Rejuvenation of the Sons of Jove at which forty candidates were initiated. The convention closed with an elaborate banquent at which covers were placed for one hundred and twelve guests.

According to telegraphic advices received by Fred L. Webster at the San Francisco office, receivers have been appointed for the Allis-Chalmers Company of Milwaukee. D. W. Call, president of that company, and Otto H. Falk of the Falk Steel Company, are the receivers, with full authority from the court to carry out all existing contracts, to make new ones and to continue the business generally. A number of orders have been taken recently and business is improving. The receivership was the result of voluntary action of the Allis-Chalmers Company, made necessary by their new reorganization plan. The present capitalization of the company consists of $25,000,000 preferred stock, of which $16,150,000 is outstanding, and an equal amount of common stock, of which $19,820,000 is outstanding. The bonds outstanding amount to $11,148,000. The plant, upon which about $10,000,000 has been expended for new construction, is said to be in fine condition.

PACIFIC GAS AND ELECTRIC MEETING.

At the regular annual meeting of the stockholders of the Pacific Gas and Electric Company at San Francisco, on April 9th, the following board of directors was elected to serve during the ensuing year: Frank B. Anderson, Henry E. Bothin, John A. Britton, W. H. Crocker, E. J. de Sabla Jr., F. G. Drum, John S. Drum, D. H. Foote, A. F. Hockenbeamer, C. O. G. Miller, Wm. G. Henshaw, John Martin, Samuel Insull (Chicago), Louis Sloss, George K. Weeks. The following officers were re-elected: President, F. G. Drum; first vice-president and general manager, John A. Britton; second vice-president and treasurer, A. F. Hockenbeamer; secretary and assistant treasurer, D. H. Foote; assistant treasurer, Jos. C. Love; assistant secretaries, Chas. L. Barrett, Morris K. Parker (New York). The new directors are C. O. G. Miller, Wm G. Henshaw and Samuel Insull. The two first named are well known to the community and represent individually prominent local interests. The entry of Mr. Insull into the directorate is significant in connection with the recent purchase by Mr. Insull and other influential Eastern associates of 40,000 shares of the common stock of the Pacific Gas and Electric Company from the estate of the late N. W. Halsey, as recently announced through the press. Mr. Insull is president of the Commonwealth Edison Company of Chicago and is also prominent in connection with other large public utility enterprises.

The following income account statement for the year 1911 was presented:

Gross revenue		$14,604,609.30
Expenditures for maintenance, operation, taxes and reserve for uncollectible accounts, casualties, etc.		8,214,071.97
Net revenue		$ 6,390,537.33
Bond interest		3,254,133.27
Balance		$ 3,136,404.06
Preferred stock dividends	$600,000.00	
Sinking fund payments	773,226.54	
Amortization of bond discount and expense	75,671.84	1,448,898.38
Balance		$ 1,687,505.68

It was announced that the company was entirely free from floating debt, had an ample cash working capital and was also well provided with funds for future construction and plant enlargements.

General Manager Britton's report showed that during the year the company constructed 408 miles of additional gas mains, 125 miles of electric transmission lines, 500 miles of electric distribution lines and 4.1 miles of street railway track. This in addition to the installation of a 20,000 Curtis steam turbine in San Francisco, a 16,000 h.p. Curtis steam turbine in Oakland and a 6,666 h.p. Curtis steam turbine in Sacramento. It was also announced that the company, preparatory to the influx of population that will follow the opening of the Panama Canal, had plans in progress for the construction of additions to its hydroelectric plants aggregating 101,000 h.p. One interesting feature of the plans for additional hydroelectric generating capacity is the construction of a reservoir with a capacity of 30,000,000,000 gallons of water, a sufficient quantity to supply the entire needs of the city of San Francisco for three years.

INDUSTRIAL

WESTINGHOUSE DIRECT-CURRENT TURBO GENERATORS.

Westinghouse type T, direct current, turbo generator units find wide application where a simple, compact, reliable generating set is desired. Many are used for exciter sets in alternating current generating stations, for lighting and power in industrial plants and in office and apartment buildings, for storage battery charging in railway signal work, and for train lighting. They are particularly applicable for exciter service in modern generating stations where the steam pressure exceeds 125 lb. per sq. in. because small reciprocating engines ordinarily used for driving exciters are usually designed for pressures not greater than 125 lb. per sq. in. Where the boiler pressure exceeds 125 lb. per sq. in., a reducing valve must be used with such engines. Type T turbines operate directly on pressures up to 200 lb. and with steam superheated to 150 degrees Fahrenheit.

As compared with reciprocating engine sets the features in favor of the Westinghouse turbo-generator set are:

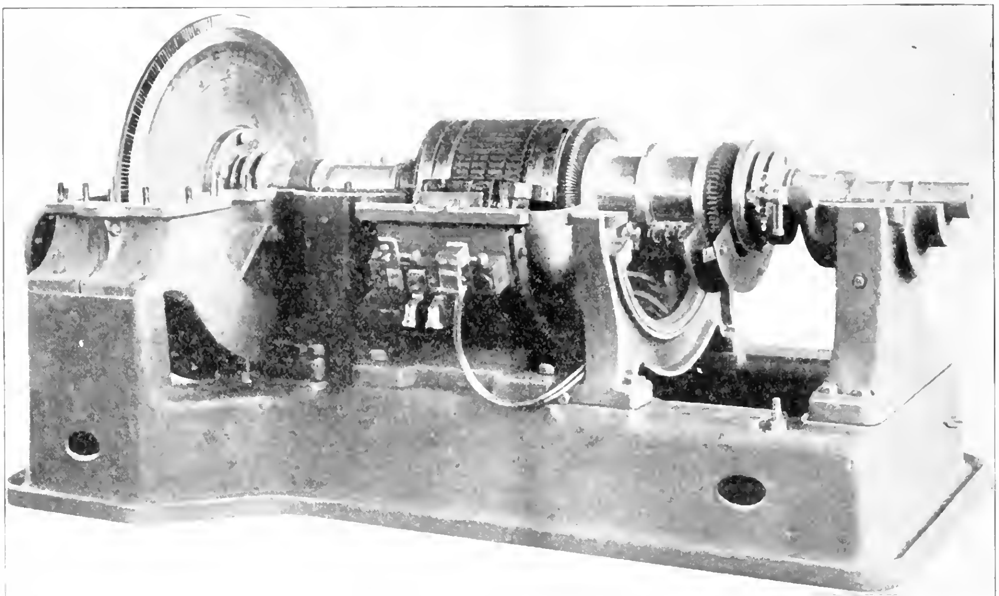
Simplicity Reliability—There are few moving parts such as rods, levers, eccentrics, and cranks. There are few parts that require attention because of wear, there are very few bearings to oil, and no stuffing boxes to pack. There are no reciprocating parts to wear out and no steam cylinders to be oiled.

Compactness—A reciprocating engine set occupies from one-half again to several times as much (depending on the speed and other characteristics) space as does a turbo-generator set.

Lower Cost of Installation—The first cost and the installation cost are less for a turbo set than for an equivalent reciprocating engine set. Expensive foundations are not required for a turbo-generator unit.

There is no oil in the exhaust steam. The line of Type T sets includes machines of the capacities most in demand of from 10 kw. to 200 kw. standard voltages are 125 and 250. Three-wire generators—125 and 250 volts—can be supplied. The steam pressure range is from 75 to 200 lb. per sq. in. Either shunt or compound wound generators can be furnished. Standard compounding is 118 volts, no load, and 125 volts, full load or 235 no load, and 250 full load. Compounding can be varied by adjusting the shunt.

The turbine is of the single wheel impulse type. The wheel or rotor is mounted directly on the end of the generator shaft. Although only one impulse wheel is used an unusually high efficiency is obtained by using the steam two or more times on the one wheel. The governor is of the fly-ball type. The weights are hung on hardened steel knife edges, minimizing friction. In case of overspeeding, the automatic safety stop throttle valve is tripped, shutting off the steam supply.



Westinghouse 100 kw., direct-current Turbo Generator Set with top casing removed, exposing runner and armature.

Type T generators are of the commutating type which insures sparkless commutation with a fixed brush position at all loads within the capacities of the machines.

A complete oiling system of the type best adapted to the service is provided with each turbine. In the smaller sizes the well known ring oiling scheme is employed. In the larger turbines the oil is circulated through a closed system, by means of a rotary pump driven by the main shaft through positive gearing.

All parts of the turbine are readily accessible for inspection or repair. The upper half of the cylinder or casing may be removed without interfering with the valve or governor mechanism, and, if necessary, the wheel or rotor may be entirely removed from the casing.

Generally speaking, the steam consumption of turbines of small powers compares favorably with the performance of automatic high speed engines of similar capacity. As Westinghouse turbines are carefully tested in the shop before shipment, there can be no uncertainty as to their performance. The guarantees of steam consumption are based on an average of actual test results, plus a comfortable margin.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The United Electric Company has been incorporated for $50,000, by J. A. Raisch, E. L. Zimmer, G. C. Collins.

PASADENA, CAL.—Pasadena Consolidated Water Company, $200,000, subscribed $400, by J. B. Coulston, J. C. Brainard and Kate M. Denny.

COLFAX, WASH.—The Whitman County Telephone Company has been organized and will incorporate with a capital of $100,000, shares to be sold at $10 each.

LOS ANGELES, CAL.—The Little Rock Power & Water Company has been incorporated with capitalization of $500,000, by G. P. Jewett, R. L. Burcham, C. W. Morrell, C. J. Cradall and G. E. Vermilyea.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the Washington Storage, Electrical, Manufacturing & Automobile Corporation, with capital stock of $50,000. They will manufacture an improved storage battery, the invention of Prof. Wm. R. Bawker of Coronado, who is secretary and treasurer of the new company.

BOISE, IDAHO.—With a capitalization of $900,000, articles of incorporation were filed for the Snake River Power Company. The incorporators are all Boise men and the object of the company is to furnish lights and power at low rates for the city of Boise. They will irrigate land along the Snake River with pumping plants. The construction of the power plants will start immediately.

OROVILLE, CAL.—The Feather River Power & Irrigation Company, a corporation backed by W. P. Hammon, the dredger magnate, has filed articles of incorporation. The company is capitalized for $10,000,000 and will build a power plant in the Feather River Canyon. It owns water rights in both Butte and Plumas counties, and will irrigate land in both these counties. The directors of the corporation are A. N. Lewis, Jr., H. J. Hill, A. L. Dahl and S. O. Vandernse.

ILLUMINATION.

ROSEVILLE, CAL.—Roseville will receive bids up to April 29, for the construction of a new electric distributing plant.

CONCONULLY, WASH.—The County Commissioners have granted the Nixon-Kimmel Company a franchise to extend their lines to furnish lights to Pateros and Brewster.

RIALTO, CAL.—Bids will be received up to May 21, for the sale of an electric franchise to maintain for a period of 50 years, an electric pole and wire system in the city.

FLORENCE, ORE.—At the recent election here the vote was in favor of granting G. G. Bushman, of Sheridan, a franchise to build, equip and operate a light plant in the city.

POCATELLO, IDAHO.—Ex-Governor J. H. Brady has ordered machinery for increasing the capacity of his company's hydroelectric power plant at American Falls, by an additional 4000 h.p.

CLARKSTON, WASH.—The Pacific Power & Light Company, which operates a system of gas lighting in Clarkston, has made application for a 50-year franchise to place and maintain gas pipes in Vineland.

CORONA, CAL.—The Pacific Light & Power Company has been granted a franchise to construct and for a period of 50 years to operate and maintain an electric pole and wire system upon all streets and alleys in this city.

VALLEJO, CAL.—At a metting of the City Council it was announced that the rates of the Pacific Gas & Electric Company in this city will be cut. The new tolls will not become effective until July 1. It was also stated that a reduction of 25 per cent on all telephone tolls will be made by the city fathers.

SALINAS, CAL.—A. M. Frost, representing the San Joaquin Light & Power Company, which has taken over the electric propositions at San Miguel, Paso Robles and other towns in San Luis Obispo county, recently bought Ulrey's plant at King City, and have applied for a blanket franchise to erect power lines on all the county highways. His application was received and ordered advertised.

PORTLAND, ORE.—The lighting and bridge committee of the City Executive Board, has voted to award the contract for installing lights on the Morrison street bridge to the Northwest Electric Engineering Company, for $3837. The contract for doing the work on the Hawthorne avenue and Burnside bridges was awarded to the West Coast Engineering Company, for $6140 on the Hawthorne and $3407 on the Burnside. When the equipment is installed, lighting facilities will be had, not only for adequate lights for traffic, but an elaborate system of decorative illumination will be supplied.

HONOLULU, T. H.—At a stockholders' meeting of the Honolulu Gas Company last week, plans were favorably discussed for an increase of the capital stock of the company by $50,000 and an increase of $100,000 in the company's bond issue, with a view to financing extension of the company's system. The capital stock is now $300,000. It is proposed to make it $350,000. There is a bond issue now outstanding of $200,000. The plan discussed at the meeting was to call in this issue and float a new loan of $300,000. While the matter was not definitely acted upon, it is understood that the stockholders are practically all in favor of it, and it will probably be carried out.

OAKLAND, CAL.—That there may be greater competition in the bidding for contracts to supply street lights than in the past, the city has been divided into five districts, and bids will be accepted for each district. Sealed bids will be opened April 22 at noon. The concerns expected to enter bids are the Pacific Gas & Electric Company, the Great Western Power Company and the Central Oakland Light & Power Company. Section 1 includes the district southwest of Market and Thirty-sixth street; section 2, the district north of section 1; section 3, that remaining portion of the city west of Lake Merritt and Grand avenue; section 4, East Oakland to Fruitvale avenue, and section 5, the remainder of the annexed district of East Oakland.

TRANSMISSION.

QUINCY, CAL.—It is reported that O. C. Pratt, president of the Indian Valley Light & Power Company is arranging to extend the transmission lines from Greenville to Crescent Mills, Taylorville and Indian Falls, early in the season.

RIVERSIDE, CAL.—The Southern Sierra Power Company, which is building a three-phase transmission line from Bishop to San Bernardino, has requested permission to build a pole line over certain of the city's streets. An application placed before the council intimates that the company would, with the city's permission, sell electric energy within the city limits. Action on the application has been deferred for one week.

RIVERSIDE, CAL.—With the letting of the contract for the steel pole line between San Bernardino and Riverside, the Southern Sierras Power Company announces that it expects to be able to deliver power by May 1. Scores of miles of distribution lines have been built in Riverside County, and an auxiliary steam plant is nearing completion at San Bernardino. That city is the objective point of the three-phase

transmission line being built from Bishop in Inyo County. The company will furnish light for the towns of Hemet, Corona, San Jacinto, Perris and Elsinore.

TULARE, CAL.—The Tulare Power Company has started up the big battery of boilers in its power plant northeast of this city for the first tryout since the plant was installed. Everything was found in excellent condition and following the test Manager C. H. Holley of the company announced that the company would be furnishing current in eight days. The first circuit to be turned on will be that running from this city to Lindsay and the Lindsay district. One hundred pumping plants have been connected up and wired in this district, representing approximately 1000 h.p. The Tulare and Exeter circuitss will next be turned on. The present plant is a steam plant and is ultimately intended to be an auxiliary, the main plant to be located on water power sites near Springville. The steam plant has contracted to deliver power April 15, and will be in shape to do this before the date set. It has been announced also that the company will extend its lines to Terra Bella and vicinity. C. H. Jackson, superintendent of the company, has sent the first carload of poles to Terra Bella and these will be strung immediately.

NEZ PERCE, IDAHO. The Lewis County Power Company has been incorporated in Idaho by A. Welch and R. B. Montague, of Portland, Oregon, to develop 125,000 horsepower on the Salmon River, the plant installation and transmission lines, representing an investment of $3,000,000. Construction work is to begin shortly and pushed to completion. The driving of a 4,000-foot tunnel through a narrow ridge provides a fall of 200 feet and empties the water again in the river at a point about seven miles below the point of intake. The initial plans provide for the driving of a tunnel through the ridge that will carry sufficient power to develop 40,000 horsepower at the beginning and the further development will be secured by the driving of a second tunnel or the enlargement of the first one. The completion of the plans will develop the 125,000 horsepower at a cost of $24 per horsepower, these estimates providing for the construction of the 200-foot dam across Salmon River at the point of intake, the driving of the necessary tunnels, the installation of the electrical equipment and the construction of the transmission lines. Mr. Welch and associates became interested in the central Idaho country a year ago, when the Nez Perce Power & Light Company was acquired. Transmission lines have since been extended to Ilo, Vollmer and Kamiah.

TRANSPORTATION.

REDWOOD CITY, CAL.—A franchise for a street railway system has been granted to Edward F. Fitzpatrick, who according to the terms of the franchise will start at once the construction of electric lines in Redwood and the vicinity.

EL PASO, TEX. Stone & Webster state that work will start on the valley interurban line as soon as a bonus of $60,000 has been deposited with some bank in El Paso, pending completion of the road; deeds to necessary right of way furnished and all other necessary rights secured.

PASADENA, CAL.—It has been reported that the issue of $2,000,000 worth of bonds of the Pasadena Rapid Transit Railroad Company has been sold to an English syndicate. The line will now be built from Pasadena to Los Angeles. Articles of incorporation for the company were filed December 31, 1908, with capital stock of $3,000,000. G. H. Hayes, W. H. Smith and Horrace M. Dobbins are directors.

DANVILLE, CAL.—John Baldwin, N. S. Bonne and Charles Goold, who are circulating the stock subscription list for the San Ramon Valley Railroad in this section, have thus far secured subscriptions totaling over $63,000. The railroad, which will be seven miles in length, will be a branch of the Oakland and Antioch electric line, connecting at Walnut Creek, and will traverse San Ramon Valley.

MARTINEZ, CAL.—Henry C. Cutting of Richmond has secured an order calling for the sale on May 6 of a franchise for an electric railway through the town of Pullman and along that portion of Cutting boulevard lying outside the city limits of Richmond. It is understood that Cutting is seeking the franchise for the Southern Pacific Railroad, which is planning to extend its Berkeley suburban lines north into Richmond.

LOS ANGELES, CAL.—The Pacific Electric Company has bought from the Pacific Light & Power Corporation, the Ontario & San Antonio Heights Electric Railroad for approximately $1,000,000. Paul Shoup states that the Pacific Electric line to San Dimas from Los Angeles will be extended 6 miles within six months, to connect with Pomona. It is said also, that right of way agents are buying land for an extension of the Stern line of the Pacific Electric out of Los Angeles to connect with the Arlington line out of Riverside. The Pomona City Council has granted the Pacific Electric a 20-year franchise for operating interurban cars through the city's streets.

WILLOWS, CAL.—The executive committee of the Sacramento Valley West Side Electric Railway has ordered a survey from Woodland via Dixon to a point on the Sacramento River, touching the line of the Oakland, Antioch and Eastern electric line. The distance from Woodland to the point of connection with the Oakland line is about 33 miles. A new survey in Colusa County for a branch has been ordered also. It will run from Williams to Colusa and will touch the Northern Electric in Colusa, the Vallejo Northern in Woodland and the Oakland and Antioch near Rio Vista. The right of way department is having great success in obtaining free rights of way. In Yolo County, from Woodland to the northern boundary of the county, the line covers 28 miles. Twenty-six miles of the right of way has been obtained.

SAN FRANCISCO, CAL. The Board of Public Works has awarded the contract for the completion of the Geary street municipal railway from Kearny street to Fifth avenue to Bates, Borland & Ayer of Oakland for $225,025. The firm is allowed fifteen days within which to sign the contract and 180 days within which to complete the work. A protest against accepting the contract on its own bid was made at the last minute by the contractors, but Mayor Rolph and members of the Board of Public Works refused to permit a withdrawal of the bid, and ordered the contractors to proceed under the specifications on pain of forfeiture of the certified check for $25,000 which was filed with the bid. Mayor Rolph explained the situation, bringing out the fact that the bid of Bates, Borland & Ayer was $28,000 lower than any other received and approximately $50,000 less than the estimate of the city engineer.

TELEPHONE AND TELEGRAPH.

SEDRO-WOOLEY, WASH.—Work is progressing rapidly on the branch line of the interurban from Burlington to this city. It is expected cars will be in operation by July 1st.

ELK CITY, IDAHO.—Wm. Sherman has gone east to interest capital in a proposition to build an electric railroad from Stites to this city, to handle the products of the mines.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has been formally petitioned by the residents in the Geneva district to extend its line to that place.

OAKLAND, CAL.—Plans are being prepared for a 4-story brick and steel addition to the Exchange Building to cost $50,000, on Franklin street, near 15th, for the Pacific States Telephone & Telegraph Company.

COLFAX, WASH.—Work of constructing a trunk line of the new Whitman County Telephone & Telegraph Company will be commenced immediately, the line to extend from Colfax to all principal Whitman county lines for a connection with local exchanges throughout the county.

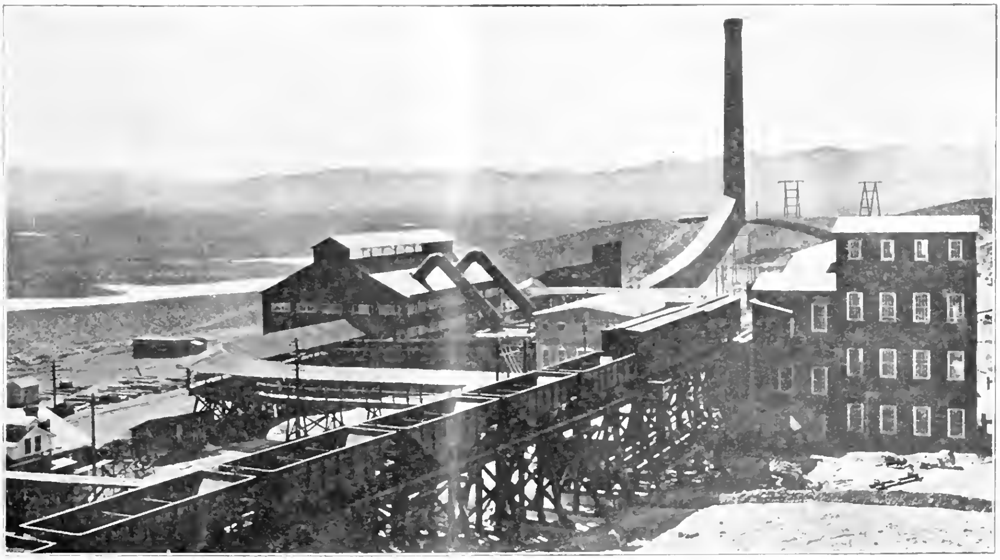
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII SAN FRANCISCO, APRIL 20, 1912 NUMBER 16

ELECTRICAL EQUIPMENT OF A NEVADA SMELTER

BY R. N. DAVIDSON.

A smelter depending wholly upon long distance electric transmission for its power, though not unusual, presents a number of interesting features. An hour's interruption in the power supply may mean an expensive freeze-up of furnaces. When it is considered how power lines are subject to winds, fires and lightning, as well as the occasional failure of some link in the long chain, at first thought such an arrangement might be criticized. However, with duplication of transmission lines, good construction and reserve capacity as at the Thompson (Nevada) smelter of the Mason Valley Mines Company, such a design is reasonably dependable.

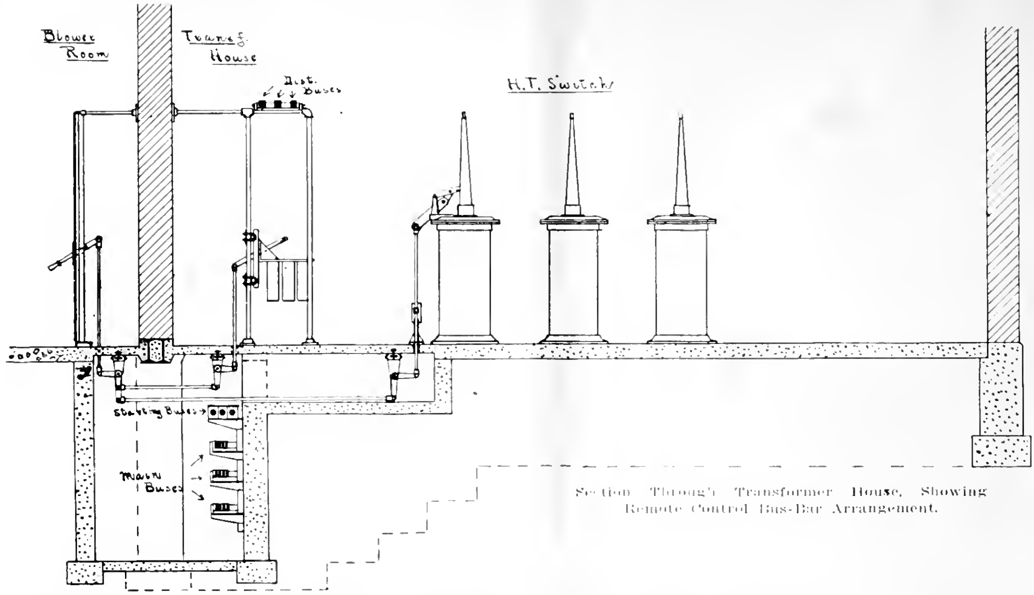


Mason Valley Smelter, Thompson, Nevada.

Power to a rated capacity of 1500 kw. is received at 66,000 volts over the lines of the Truckee River General Electric Company. Duplicate lines traverse different routes, and, as ordinarily operated, constitute a ring system. The several hydroelectric power plants are situated along the Truckee River, the nearest a hundred miles from the smelter. There are double and even triple lines between them, so that a supply of power is always assured.

As the region is arid, comparatively little lightning is experienced along the lines. These are substantially built, the form of support being double wooden cross-arms 26 ft. long on two 50 ft. cedar poles 12 ft. apart. The wires are hung from suspension insulators and the spacing is planned for operation at 100,000 volts. The poles also carry a pair of copper-clad steel telephone wires.

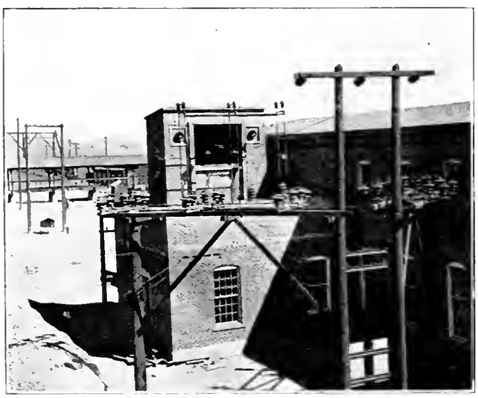
The poles' top switches control the smelter high voltage bus bars and are operated from within the transformer house. In case of trouble on one line the attendant, in touch with the Truckee River Com-



Section Through Transformer House, Showing Remote Control Bus-Bar Arrangement.

pany's dispatcher by telephone, can open the paralleling switch near by and then, by means of one or other of these two switches, get on the good line.

The location of the lightning arrester house and horn gaps on top of the transformer house allows a neat arrangement of the high-voltage wiring; and the openings through the roof inside the arrester house and behind the electrolytic tanks permit the warm air from the transformer room to ascend and keep the electrolyte from freezing.



Top Switches and Transformer House.

The transformer house itself is of brick with reinforced concrete roof supported on I-beams. The interior is whitened and all the high-voltage conductors are of copper tubing. These conductors are supported by regular line insulators of the pin type hanging right side up from stems of iron pipe and railing flanges bolted to the steel roof beams.

The current enters through compound-filled roof bushings to choke coils mounted upon the wall to a Westinghouse GA oil switch whose three tanks rest of the floor. The three 500 k.v.a. single-phase transformers are of the water-cooled shell type and are operated in delta on 66 kilovolts.

Single conductor cables, two 500,000 cm. in parallel, carry the 440-volt power down in front of the

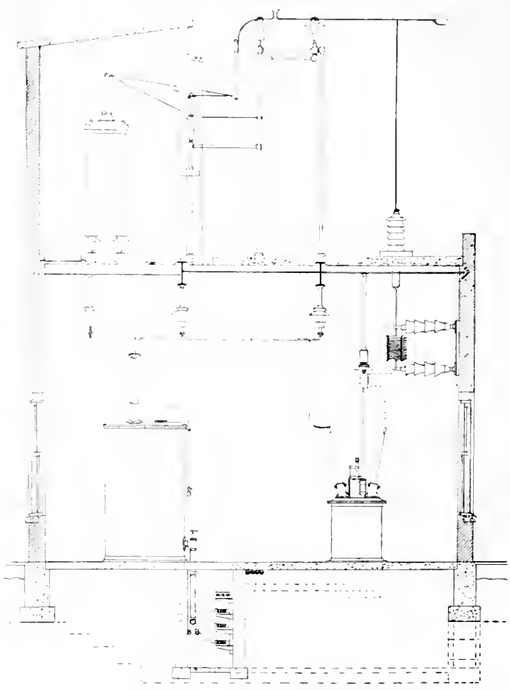


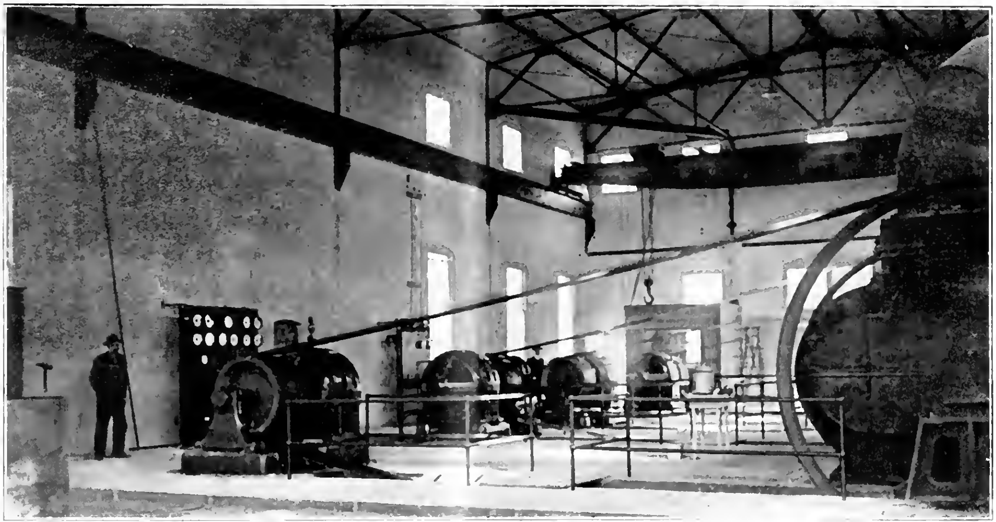
Diagram of Transformer Connections.

transformers in line with the piping for the cooling water into a subway to bus bars leading to the switch frame. This underground location of piping and busses gives a clear space in front so that to replace or repair one of the transformers it can be moved forward and out of the building without much delay.

Eighty per cent of the electric energy is consumed in the blowers and the location of the transformer house adjacent to the blower room allows the same attachment to care for both. The switch board is placed in the blower room on the opposite side of the wall from the switches which are in the transformer room and with which there is mechanical connection by means of rods and bell cranks.

at outlets the conduit itself is bushed down to the lead sheath with filled wood, except on the upper ends of vertical conduits outside, where GV pipe caps are used.

On the outside pole lines where the leads are heavy, two-post construction is used, and at corners four-post towers are built. On pole lines bare wire is used exclusively, being entirely on the company's property. It is considered that plain pole line hardware is superior to galvanized in a dry climate under the acid action of smelter fumes. For lighting both on smelter-site and townsite separate 440-volt circuits come out from the switch frame and transformers are hung on the poles to step down to the



Blower Room Showing Switchboard and Blower Units.

The blowing units consist of a Connellsville blower with a driving pulley on either end on each revolving element. They are accordingly driven by twin 200 h.p. slow speed motors belted and rotating in opposite directions. Theoretically, no power is transmitted by the gears as they serve only to keep the revolving pistons in proper relation. A 100 kw. motor-generator set with its own control board for the haulage systems is also along what may be called the electric side of the blower room.

Three low-voltage taps at corresponding points around the delta allow the main transformers to be used to start the motors in the blower room. Although this idea means three separate starting busses and one more conductor in the subway than if the usual open-V starting busses had been used, it compels each transformer to do its share of starting and is more flexible in case one transformer is disabled.

All conductors leading from the switch frame, both to blower room motors and to outside lines, are triple-conductor, rubber-insulated, lead-sheathed cable in iron conduit. Instead of expensive conduit fittings

110/220 volt three-wire system. One of the power circuits supplies the sample mill and the other has the remaining miscellaneous outside power such as three pumping stations, machine shop, carpenter shop, alternating current crane, clay mill and sintering plant.

Ore is conveyed from the storage bins to the blast furnaces in side-dumping cars drawn in trains of seven each by four-ton locomotives running on a twenty-four inch gauge track. This system is elevated on framed timbers and roofed over. The trolley is offset in order to pass behind the scale hoppers under the ore bins. It fastens directly to the roof structure above. The trolley wire for the locomotive which handles the slag larries below the blast furnaces is suspended on span wires between buildings. At the dumps it is supported by special brackets which are mounted so as to move with the track when it is shifted. The slag pots are dumped by a motor controlled by the motorman in his cab.

The general design of the transformer house is due to M. C. Godbe, of Salt Lake City, while the detail work and construction were in charge of the writer.

WESTERN LAWS OF ELECTRICITY AND WATER

THE LAW OF UNDERGROUND WATERS.

BY A. E. CHANDLER.

According to the Thirteenth Census the source of water supply for 433,630 acres of the total of 13,739,500 acres irrigated in 1909 in the Western States was wells. Of this area 332,410 acres were irrigated from wells in California, for which the total was 2,664,100 acres. Although the area so irrigated is but a small percentage of the total, it is constantly increasing. The surface supply is being rapidly exhausted and future development in certain sections must rest entirely upon the underground supply. This fact is so well recognized in California that the larger power companies have initiated a campaign of education to interest farmers in the use of electric power for pumping. They have installed a working exhibit on the University of California demonstration train and keep an expert in attendance to explain the operation of motors and pumps. The gas engine and pump manufacturers are equally interested and through their catalogues are making an effective argument for the introduction of pumping plants for irrigation.

There are two classes of natural underground waters—percolating waters and those that flow in a defined subterranean channel. Percolating waters have been well designated "vagrant, wandering drops moving by gravity in any and every direction along the line of least resistance."

Illustrations of underground waters moving in a defined channel are very familiar, and the so-called "sub-flow" of streams is especially common. In a former article the recent case of Miller v. Bay Cities Water Company was considered at some length. Although the court therein discusses the California cases on percolating waters, Miller's source of supply was clearly a "subterranean channel," and his right the same as that of a riparian owner on a surface stream. Waters in subterranean channels have always been considered subject to the same legal principles as the waters of surface streams. In most jurisdictions underground waters are presumed to be percolating and the burden of proving the existence of a known and defined channel is on the one so asserting.

The common law rule is that percolating waters belong to the owner of the surface and such rule is generally accepted except as later stated in this article. An early California case—Hanson v. McCue (42 Cal. 303)— adopts the rule in the following language.

> Water filtrating or percolating in the soil belongs to the owner of the freehold—like rocks and minerals found there. It exists there free from the usufructory right of others, which is to be respected by the owner of an estate through which a defined stream of water is found to flow. The owner may appropriate the percolation and filtrations as he may choose, and turn them to profit if he can.

It must be appreciated that the task of showing the difference between the two classes of underground waters in a given case is very difficult. It means the introduction of much expert testimony with the usual conflict in scientific views. An excellent illustration is the pioneer case of Los Angeles v. Pomeroy (124 Cal. 597) wherein the city sought to condemn land in the San Fernando Valley for use in connection with its water supply system from the Los Angeles River. The city contended that the waters under the surface of the tract in question composed the subterranean flow of the Los Angeles River and therefore belonged to it under its "pueblo right"—a right under the Mexican law giving the pueblo paramount interest in the waters of streams. Pomeroy claimed that such waters were but percolating waters and therefore belonged to him as owner of the soil. Very elaborate models and relief maps were introduced in connection with the expert testimony on each side and the court finally decided that the evidence showed the existence of a well defined channel and that the underground waters were therefore part of the flow of the Los Angeles River and not percolating waters.

California is the only Western State which has thus far departed from the common law rule of percolating waters. In the now celebrated case of Katz v. Walkinshaw (141 Cal. 116) the plaintiffs sought "to enjoin defendant from drawing off and diverting water from an artesian belt, which is in part on or under the premises of plaintiffs, and to the water of which they have sunk wells" for water for domestic purposes and for irrigating their lands overlying the artesian water. The defendant diverted "the water for sale, to be used on lands of others distant from the saturated belt." The plaintiffs contended that the subsurface water constituted an underground stream and that they were riparian thereto. The defendant on the contrary alleged that the water rising in her wells was percolating water and therefore her property. The original opinion of the Supreme Court in the case, written by Mr. Justice Temple, was handed down November 7, 1902. The court therein held that the artesian body was percolating water and not an underground water course to which riparian rights could attach. Instead of holding, as the lower court had done, that the defendant could not be enjoined, the Supreme Court after citing the authorities and dwelling on the difference in conditions "in a country like Southern California, where the relative importance of percolating water and water flowing in definite water courses is greatly changed," concluded that a different rule was required and established the new rule of reasonable use.

A rehearing was granted in order that additional arguments might be presented by those "not parties to the action, but vitally interested in the principle involved," and the final opinion, written by Mr. Justice Shaw, was handed down on November 28, 1903. The opinion is very important on account of its treatment of the common law, in addition to the modification of the law of percolating waters, as shown by the following extract:

The idea that the doctrine contended for by the defendant is a part of the common law adopted by our statute, and beyond the power of the court to change or modify, is founded upon the misconception of the extent to which the common law is adopted by such statutory provisions, and a failure to observe some of the rules and principles of the common law itself. In Crandall v. Woods, 8 Cal. 143, the court approved the following rule, quoting from the dissenting opinion of Bronson, J., in Starr v. Child, 20 Wend. 149: "I think no doctrine better settled than that such portions of the law of England as are not adapted to our condition form no part of the law of this State. This exception includes not only such laws as are inconsistent with the spirit of our institutions, but such as are framed with special reference to the physical condition of a country differing widely from our own. It is contrary to the spirit of the common law itself to apply a rule founded on a particular reason to a case where that reason utterly fails."

(It is a noteworthy point that the language of Mr. Justice Bronson quoted by Mr. Justice Shaw, was also quoted by Mr. Justice Ross in his dissenting opinion in Lux v. Haggin, wherein he argued that the common law rule of riparian rights, being unsuited to the existing conditions, should be rejected in California.)

After other forcible statements in regard to the adaptability and power of modification of the common law, the opinion describes at considerable length the semi-arid conditions existing in a large part of California ("in almost all of the southern half of it"), the insufficiency of the natural streams as sources of irrigation supply, and the absolute need of the utilization of the underground waters. Following the statement that "The claim that the doctrine stated by Mr. Justice Temple is contrary to all the decisions of the court is not sustained by an examination of the cases," it proceeds to analyze the former California cases supposedly upholding the common law rule of percolating waters, beginning with Hanson v. McCue, and concludes:

In view of this conflicting and uncertain condition of authorities it cannot be successfully claimed that the doctrine of absolute ownership is well established in this State. It is proper to state that in all the opinions which have so far quoted and approved the supposed common law rule, the injuries from interference with percolating waters were too obscure in origin and cause, too trifling in extent, and relatively of too little importance, as compared to mining industries or the wants of large cities, to justify or require the recognition by the courts of any correlative rights in such waters, or redress of such injuries, there has been no notice at all taken of the conditions existing here, so radically opposite to those prevailing where the doctrine arose. It is also to be observed that in some instances in the Eastern States, mentioned in the former opinion in this case, the injustice from the diversion of percolating waters has been so glaring and so extensive that the court there was compelled to depart from its previously decided cases and recognize the rights of adjoining owners.

The new rule established by the decision is well shown in the following paragraphs:

In controversies between an appropriator for use on distant land and those who own land overlying the water bearing strata, there may be two classes of such land owners: those who have used the water on their land before the attempt to appropriate, and those who have not previously used it, but who claim the right afterward to do so. Under the decision in this case the rights of the first class of land owners are paramount to that of one who takes the water to distant land; but the land owner's right extends only to the quantity of water that is necessary for use on his land, and the appropriator may take the surplus. As to those land owners who begin the use after the appropriation, and who, in order to obtain the water, must restrict or restrain the diversion to distant lands or places, it is perhaps best not to state a positive rule until a case arises. Such rights are limited at most to the quantity necessary for use, and the disputes will not be so serious as those between rival appropriators.

Disputes between overlying land owners, concerning water for use on the land, to which they have an equal right, in cases where the supply is insufficient for all, are to be settled by giving to each a fair and just proportion. And here again we leave for future settlement the question as to the priority of rights between such owners who begin the use of the water at different times. The parties interested in the question are not before us.

Katz v. Walkinshaw has been consistently followed in all subsequent percolating water cases arising in California. As far as the establishment of further rules is concerned, the most important of the subsequent cases is Burr v. Maclay Rancho Water Company (154 Cal. 428) decided in 1908, as the question left undecided in Katz v. Walkinshaw was presented. The plaintiff therein "sued to enjoin the defendant company from pumping water from its wells on land adjoining that of plaintiff and transporting such water to distant lands for irrigation." The plaintiff's land consists of three tracts—blocks 153, 190 and 191 of the Maclay Rancho Ex-Mission San Fernando. The three tracts overly the body of percolating water. Plaintiff's wells are on block 191 which is an irrigated orchard. For a short time part of block 190 was also irrigated. The right is claimed for the irrigation of all of blocks 153 and 190 as well as the present irrigated block 191. Defendant's wells are on block 192 and while its pumps are being operated "it is impossible for the plaintiff to obtain any water from his wells by means of his pumps."

In the consideration of the case the Court comments on the contrast between the new doctrine of percolating waters and the rule of riparian rights in regard to true conservation as follows:

It is not the policy of the law to permit any of the available waters of the country to remain unused, or to allow one having the natural advantage of a situation which gives him a legal right to water to prevent another from using it, while he himself does not desire to do so. The established and settled law of riparian rights in running streams, which have become vested rights, may compel a different rule with regard to such waters in some instances, but these rules of law do not, of necessity, control rights in percolating waters.

Certain headnotes used in reporting the case so well set forth the principles established that they are quoted in full:

Different owners of separate tracts of land, situated over common strata of percolating water, may, each upon his own lands, take by means of wells and pumps from the common strata, such quantity of water as may be reasonably necessary for beneficial use upon his land, or his reasonable proportion of such water, if there is not enough for all, but one cannot, to the injury of the other, take such waters from the strata and conduct it to distant lands not situated over the same water bearing strata.

As between an appropriator of percolating water for use on distant land, and an owner of land overlying the water bearing strata, who was using the water on his land before the attempt to appropriate, the rights of the overlying landowner are paramount. Such rights, however, extend only to the quantity of water that is necessary for use on his land, and the appropriator may take the surplus.

After an appropriator of water from a common water-bearing strata has begun to take water therefrom to distant lands not situated over the strata, for use on such distant lands, the owner of other overlying land upon which he has never used the water, may invoke the aid of a court of equity to protect him in his right to thereafter use such water on his land, and thus prevent the appropriator from defeating his right, or acquiring a paramount right by adverse use, or by lapse of time. Such an appropriation for distant lands is subject to the reasonable use of the water on lands overlying the supply, particularly in the case of persons who have acquired the lands because of these natural advantages.

As against the owners of such overlying lands, either those who have used the water on their lands before the attempt to appropriate, or those who have not previously used it, but who claim the right afterwards to do so, the appropriator for use on distant land has the right to any surplus that may exist. If the adjoining overlying owner does not use the water, the appropriator may take all the regular supply to distant land until such landowner is prepared to use it and begins to do so.

In controversies between the owners of such overlying lands, and an appropriator of the water for use on distant lands, the court has the power to make reasonable regulations for the use of the water by the respective parties, fixing the times when each may take it and the quantity to be taken, provided they be adequate to protect the person having the paramount right in the substantial enjoyment of that right and to prevent its ultimate destruction. In the present case the judgment is directed to be modified in accordance with these rules.

Although the new rule of percolating waters is now so firmly established in California, no other Western State has thus far adopted it, although the tendency seems that way. The Supreme Court of Idaho in Le Quime v. Chambers (98 Pac. 415) dealing with the appropriation of spring waters commented on the establishment of the new rule in California, but, as it considered the law of underground waters not necessary to the case before it, did not follow it. The Supreme Court of New Mexico in Vanderwork v. Hewes (110 Pac. 567) treated the new rule in the same way as the Idaho court. The Supreme Court of Colorado in Smith Canal v. Colorado Ice Co. (98 Pac 940) after referring to Katz v. Walkinshaw, stated:

The law regulating ownership of percolating waters in the arid States is now of great—as time passes it will be still greater—importance, and, until a proper case is presented calling for it, we decline to announce the rule applicable to our local conditions.

As stated in McClintock v. Hudson (141 Cal. 275) the new rule regarding percolating water "makes it to a great extent immaterial whether the waters in this land were or were not a part of an underground stream" provided the withdrawal of such waters by defendant can be shown to substantially affect the source of supply—well or stream—of plaintiff. The need of distinguishing between the two classes of underground waters still exists in all the Western States except California, and in the latter the problem of proving the alleged damage to a source of supply remains and is generally a difficult one.

Contrast of the California Rules of Percolating Waters and of Riparian Rights.

The owner of land overlying a body of percolating water corresponds to a riparian owner on a surface stream, and an appropriator of percolating waters for use on distant lands (that is, not overlying) corresponds to an appropriator of surface waters for use on non-riparian lands. Under the rule of riparian rights the riparian owner may perpetually enjoin the diversion or storage of the waters of a stream when such diversion is or may be of injury to him; and in the consideration of the question of probable damages the riparian owner cannot be restricted to a reasonable use. Under the new rule of percolating waters the times and amounts of use by overlying owner and appropriator may be fixed by the Court so that the overlying owner will have the first use of a reasonable amount for his overlying land and the appropriator the surplus for the distant land; and in cases of present non-use by the overlying owner, the appropriator will be allowed to withdraw the water until the former is ready to use it. In brief, the new rule of percolating waters allows the widest possible use of the source of supply, while the rule of riparian rights results in waste. It is rather paradoxical to have the sub-surface supply, which is naturally conserved in the underground reservoirs, regulated by a wise rule, while the surface supply, which unless artificially stored or reasonably used must run to waste, remains unregulated.

In a former paper it was stated that the case of Lux v. Haggin fixed the modified doctrine of riparian rights in California seemingly for all time. This was so written as the general view, even among those strenuously opposed to the doctrine, is that the Supreme Court of California could not seriously consider the abrogation of the doctrine on account of the extensive rights which have been recognized as vested by the long line of decisions following the lead of Lux v. Haggin. It is believed, however, that the riparian rights of consequence to single proprietors belong to the Spanish grants; that the most of these have been long irrigated and therefore fully protected under the doctrine of appropriation; and that those that remain are being or will be subdivided into small tracts, comparatively few of which will retain the riparian right, and which will therefore be better served by the doctrine of appropriation. There remain in addition to the grants the public land subdivisions immediately touched or crossed by the streams, and which lie in such narrow strips that usually no feasible irrigation scheme can be made to include them without including non-riparian lands also—that is, without resting on the doctrine of appropriation. The abrogation of the riparian rule would therefore not materially injure single proprietors, the aggregate of whose holdings now seriously retards the promotion of storage works.

Lux v. Haggin fixed the rule of riparian rights for the reason that California had adopted the common law and that it was the doctrine of the common law. Katz v. Walkinshaw rejected the common law rule of percolating waters as unsuited to the conditions existing in California.

The court in Lux v. Haggin undoubtedly considered the riparian rule the best for the interests of the State, and looked upon the doctrine of appropriation as one certain to result in monopolies of the water supply. The present day view of this latter doctrine will be presented in the next article, and, it is believed, the "monopolistic" idea will be shown to be untenable.

COSTS OF ENGINEERING INSTRUCTION IN THE NORTHWEST.

An interesting paper was recently read before the Portland section of the American Institute of Electrical Engineers by W. A. Hillebrand, professor of electrical engineering at the Oregon Agricultural College. The paper deals with the problem of efficiency in teaching.

The data collected on costs per student-hour of instruction is unique and instructive.

In the courses given by the Department of Electrical Engineering at the Oregon Agricultural College there will probably be offered this year, seven thousand, three hundred (7300) student hours of instruction, or with a faculty of two and two-thirds men, for two instructors are shared by this and the Department of Physics, twenty-seven hundred and forty (2740) student hours per man. The imaginary schedule is admittedly light, which places our Oregon institution almost in the same class, as regards opportunity.

Since the question of efficiency in teaching is inseparably bound up with that of finance which provides the necessary funds, it should be of interest to ascertain, if only in an individual case, what the cost of instruction may be or actually is.

The courses offered by our department this year are as follows:

Junior laboratory course	.....	2	semesters	2	credits each
" recitation	"	2	"	3	"
Senior laboratory	"	2	"	2	"
" recitation	"	2	"	3	"
" design	"	2	"	2	"
" thesis	"	1	"	2	"

In the Junior class there are eighteen men and in the Senior class eleven with a total of 7300 student hours and 413 credit hours, which totals cannot be deduced alone from the above table.

The cost of instruction is subdivided as follows:

Teaching salaries, labor and supplies used solely by the department in connection with the above enumerated courses	$4,325.00
College administration and maintenance, Electrical Department share	899.00
Fixed charges, interest and depreciation	1,360.00
Total	$6,584.00

Administration and maintenance cover the expenses of the executive, registrar and business offices, publications and care of grounds apportioned in the proportion of the number of students taking work in our department to the total registration. A better division would perhaps be founded on the proportion of student hours instruction to the total for the college, but these figures are not available. This item of expense also covers janitorial service and heating, apportioned in the ratio of floor space occupied by our department to the total floor space, estimated of the college.

Fixed charges include interest at four per cent. This figure is the one used by Mr. Cooke in his report to the Carnegie Foundation. It seems legitimate to charge interest because the college plant was provided by the taxpayers of the State with funds which might otherwise be productive.

Depreciation is figured at the following rates: buildings 2 per cent; electrical equipment, 5 per cent; wire plant, property of college, 8 per cent; heating plant, 4 per cent; printing office equipment, 5 per cent.

a. Students enrolled in Electrical Department 30
b. Total enrollment of full course students 1066
  Ratio, a/b is .0283, or 2.83 per cent.
c. Floor space occupied by department .... 4,135 sq. ft
d. Floor space, class rooms, laboratories and offices in Mechanical Hall, home of E. E. Dept. .... 17,230 " "
  Ratio, c/d is .25, or 25 per cent.
e. Floor space for entire college (estimated) .... 353,000 " "
  Ratio, c/e is .012, or 1.2 per cent

Fixed charges were computed and apportioned to the department as follows:

Mechanical Hall, 30,000 × .25 × (.02 plus .04)	$ 450.00
Departmental equipment, $8,500 × (.04 plus .05)	756.00
Campus lands, $15,000 × .04 × .0283	17.00
Power plant, $19,000 × (.04 plus .05) × .0283	48.00
Wire plant, $5,000 × (.04 plus .08) × .0283	17.00
Heating plant, $34,000 × (.04 plus .04) × .012	32.00
Printing plant, $5,500 × (.04 plus .05) × .0283	14.00
Administration offices, $5,500 × (.02 plus .04) × .0283	17.00
	$1,360.00

Although the estimated value of land on the campus is about $200,000, only the approximate purchase value was used in computing cost.

Ratio salaries, etc., to total cost	65.5%
Ratio administration and maintenance to total cost	13.6%
Ratio fixes charges to total cost	20.9%

Cost per student hour, $6,584.00 divided by 7,300 is $0.90
Cost per credit hour, $6,584.00 divided by 413 is $15.95

For every registered hour a student spends with an instructor in our department it costs ninety cents. It is interesting to note that this value lies within the range reported by Mr. Cooke as the cost per student hour in physics at eight prominent Eastern and Middle Western colleges and universities. His costs average $0.87.

Assuming that the salary roll should vary about as the number of students, the cost of instruction may be represented by the following formula, where x equals the number of credit hours in courses offered by the department.

Annual cost, $2,259.00 + 10.50 x (10.50 equals salaries, etc., per credit hour in 1911-12). The amount which annually must be provided to run the department is given by the formula

$$899 + 10.50x + y.$$

where y is the annual equipment appropriation, which may vary from nothing to whatever the authorities feel can be afforded.

Doubtless the most perplexing question confronting every college president concerns the distribution of the annual appropriation. The author believes that a careful analysis of costs would be of material assistance in answering this question, and that, in general, a low cost per student hour will be a sign of inefficiency.

In striving for efficiency in teaching as in any other endeavor, we believe it necessary to possess a clear realization of the end sought, of the method which shall be followed and of the equipment and personnel required. Some conception of the necessary expense is also considered desirable.

PACIFIC COAST A. I. E. E. MEETING

The Portland meeting of the American Institute of Electrical Engineers which is just closing may easily be classified as one of the most interesting and profitable ever held in the West. Graced by the presence of Gano Dunn, president of the national body, the meeting drew forth many talented and eminent engineers of the West.

The following papers were presented:

"Operation of Two Alternating Current Stations Through Parallel Circuits and the Distribution of Load and Wattless Current Between Them," by J. W. Welsh.

"Air Gap, Flux Distribution in Direct Current Machines," by Charles R. Moore.

"Principles to Be Considered in Selecting a Water-Wheel Unit," by O. B. Coldwell.

"Irrigation in the Spokane Valley," by L. J. Corbett.

"An Underground System and a Few Developments," by S. B. Clark.

"Alternating Current Systems of Underground Distribution," by S. J. Lisberger and C. J. Wilson.

"Automatic Private Branch Exchange Development in San Francisco," by Gerald Deakin.

"Application of Automatic Selecting Devices to Telephone Multiple Switchboards," by Alfred H. Dyson.

"Plant Efficiency," by J. D. Ross.

"Practical Joint Pole Construction," by J. E. Macdonald.

"Design of Telephone Pole Lines for Conditions West of the Rocky Mountains," by A. H. Griswold.

"Arc vs. Tungsten Street Lighting in Small Towns," by C. E. Stephens.

"Mechanical Results of the Use of Suspension Insulators," by V. H. Greisser.

"Long Distance Telephone Transmission on the Pacific Coast," by C. A. Turner.

The following is an abstract and summary of various papers presented:

SELECTION OF A WATER WHEEL UNIT.

BY O. B. COLDWELL.

The conditions which must be met with in the particular plant where the installation is to be made determine the general make-up of the unit. Water wheels may have but a single runner, may have a pair of runners, or for low heads, four or even six runners to the unit. In some places a vertical design of unit is required, while in others horizontal units best suit the conditions in many instances, it is merely a matter of taste, but in most cases there are features which influence the selection of horizontal or vertical units.

When a pair of wheels is used, it must be determined whether an outward discharge or a bottom center discharge is the more desirable. Both schemes are used, one involving a single draft tube, the other two draft tubes.

When low heads are met with, open flumes are possible and a properly arranged open flume may take the place of the closed flume. In high head work it is, of course, necessary to use a closed flume.

The housing enclosing the runners may have various forms. For instance, it can be a scroll case design or a cylindrical design; it can be made out of cast iron, cast steel or steel plate or may even be formed in concrete. The scroll case has high economy on account of the water passages being designed so as to give a proper increase in velocity before the water enters the runners.

There are many other types of flumes, such as the cone shaped type. This type has ordinarily high economy, but has the disadvantage of a bearing which is not readily accessible.

Consideration must be given as to whether the inlet of the unit is to be beneath the floor line or above; the general question of accessibility of the various parts of the unit, the location of the governor, and many other points must be given attention. Racks of ample area must be provided at the intake in order that there may be low velocities through same and little loss of head. The pipe line must have careful consideration and proper velocities must be selected.

In plants with long pipe lines, the speed regulation and the consequent pressure variation is of great importance, as the latter has to do with the strength necessary and, therefore, the design of the pipe line. In some cases, pressure regulators are necessary. Again, surge tanks may be used. The draft tube must have proper attention and the tail-race be such as to give low velocities. If the tail-race is restricted, the total head is affected.

In order that the purchaser and water wheel manufacturer may have at hand when the wheel is being designed data covering all of the points which should enter into the design, it has been thought advisable to give a list of questions which should be filled out as completely as possible by the purchaser and sent to the manufacturing company for use when making his wheel.

Data to Be Given to Water Wheel Manufacturer.

1. Number of units.
2. Horsepower of water wheels.
3. Kw. of generator.
4. Total head.
5. Open flume or closed flume.
6. If closed flume, what is number of pipes?
7. What kind of pipe? wooden stave, steel or concrete?
8. Diameter of pipes.
9. Effective head (unless design of all water passages to and from wheel is left to water wheel manufacturer).
10. Head water elevation.
11. Floor elevation.
12. Tail water elevation.
13. Head variable, if so, what is normal operating head?
14. If head is variable, what is the range of variation?
15. How important is power and economy at lowest head?
16. Speed of generater, if already decided.
17. If speed of generator is not decided, name speeds which seem to purchaser most desirable and ask recommendations.
18. Flywheel effect of generator.
19. What speed regulation is desired for different load changes?
20. Will units run in parallel with other plants? If so, give general characteristics of such plants.
21. If running in parallel with other plants, can these plants be used to regulate the system?
22. What is the character of load factor?
23. What is the nature of water (silty or clear)?
24. What date shipment of material is desired.
25. Advise if it is expected that manufacturer shall furnish governor.
26. Give sketches of power plant site.
27. Give information as to what is to be expected in the way of guarantees.
28. Give any other information which you think would influence the design of the wheel.

It will not be attempted here to outline the specifications which should be made out to cover the purchase of the water wheel unit, but a list of data which should be supplied by the water wheel company is offered.

Data to Be Supplied to Purchaser by Water Wheel Manufacturer.

1. A check of the calculation on effective head.
2. Horsepower guarantee at normal head.
3. Guarantee at other heads, if head is variable.
4. Speed guarantee, including runaway speed.
5. Recommendation for best speed if same has not been determined.
6. Speed regulation guarantees.
7. Efficiency guarantees at full load, ¾ load and ½ load
8. Point of greatest efficiency of wheel and value of same in per cent.
9. Efficiency guarantees for available head conditions.
10. If water wheel manufacturer furnishes governor, give information as to the type, make, power required to operate same, also what variation in speed will not be exceeded before the governor will begin to readjust gates to meet a change of load, either gradual or sudden.

    In what time will governor completely open or close gates? Within how many seconds will the speed of the unit be restored to normal?
11. Complete drawings showing machinery proposed.
12. Complete description of machinery proposed
13. Gurantee of durability
14. Guarantee of shipment.

ALTERNATING CURRENT SYSTEMS OF UNDERGROUND DISTRIBUTION.

BY S. J. LISBERGER AND C. J. WILSON

In most cities where electric energy is distributed underground, particularly in congested sections, the Edison three-wire, 200-volt direct current system is used.

Comparison of Direct and Alternating Current Systems

Omitting considerations of first cost, the direct current system is preferable by reason of its simplicity and reliability; also, it is more flexible in operation.

Automatic regulators perform the same functions for the alternating current feeders that the several bus pressures do in the direct current system. The direct current system feeds into a common network, the feeders and mains being tied together through suitable junction and fuse boxes. The load on a direct current feeder rarely exceeds 300 kw., whereas an alternating current feeder, for economical distribution, carries ordinarily a load of 1000 kw. An alternating current feeder supplies a considerable number of mains, to which cross connection is made.

The secondary systems of alternating and direct current are similar in design. Due to the wide extent of territory covered by the feeder and mains, and to the large load connected to same, suitable emergency ties, junction boxes, oil fuses, etc., must be provided to sectionalize the portions of the system that may be affected, or upon which work must be performed. The necessity for these auxiliary devices is apparent when considering the high potential of the alternating current system as compared with the low potential of the direct current system.

Reasons for Adoption of Alternating Current Systems.

This paper is not intended to advocate the application of alternating current to an underground system as against direct current, but to present some reasons why alternating current must sometimes be adopted instead of direct current.

On the Pacific Coast many cities are supplied entirely or in part from hydroelectric transmission systems. In the inception current was distributed overhead at 2400 volts, two or three-phase, and transformed to 120/240 volts, single or polyphase, for light and power. A single substation supplied a wide area. Low rates induced the extensive application of alternating current apparatus. When city ordinances demanded the undergrounding of wires, operating companies were confronted with the problem of continuing the alternating current system or changing all the apparatus for use on direct current.

Financial considerations did not admit of a change of system. The necessity of building more substations, resulting in higher investment costs in lands, buildings, station equipment, storage batteries, and the expense of replacing consumers' apparatus, made the engineers reluctant to recommend the adoption of direct current. It should be borne in mind that the cost of installing storage batteries was prohibitive, and without battery standby the advantages of a direct current system were to a certain extent offset. The practice of competing companies was to install an alternating current system solely for reasons of first cost. Competition therefore demanded that alternating current be available.

Neglecting the question of competition, there is a growing demand for alternating current service, particularly for low-voltage sign lighting and other devices which can be used only on alternating current.

The authors in the foregoing have endeavored to outline why alternating current service must be supplied in underground territories. This paper will cover a description of this system as used in the territories supplied by the Pacific Gas & Electric Company. The discussions will not pertain to conduit or manhole construction, nor any details pertaining to types of cables used.

In certain territories both direct and alternating current are supplied for lighting and power purposes; in other territories where only alternating current is supplied for lighting and power purposes, direct current, for elevators and other types of apparatus demanding direct current, is supplied at 550 volts, no lighting being carried on this system.

The description following will apply only to the alternating current installation.

No fuses are used in the primary system, except on transformers, as practice has demonstrated that fusing of mains is unsatisfactory and further complicates the operation of the system. In two cities where we are supplying loads of 3000 kw. in a small congested district no trouble has been experienced on the general system during three years of operation, in which time faults have occurred on the secondary system, and in transformers, which were successfully cleared by the secondary fuses and the transformer oil fuses.

Conclusions.

Our experience with an alternating current system, the load on which aggregates 12,000 kw., has demonstrated that the system can be successfully operated. The design and operation of an underground alternating system, as compared with a direct

current system, should present no serious difficulties—provided, however, that suitable sectionalizing devices are obtained for use on the high-voltage parts of the system.

Safety to the workmen, and continuity of service, demand the use of more reliable apparatus on an alternating current system than is required on a direct current system.

Questions of comparative cost between the alternating and direct current systems have been purposely omitted, as the price of real estate, substations, and equipment will greatly affect the investment. The additional cost of sectionalizing devices for the alternating current underground system is small as compared with the costs of the direct current system. Load, service, and competitive conditions will be important factors in the choice of the system.

PLANT EFFICIENCY.

An Analysis of the Losses of a Hydroelectric System.

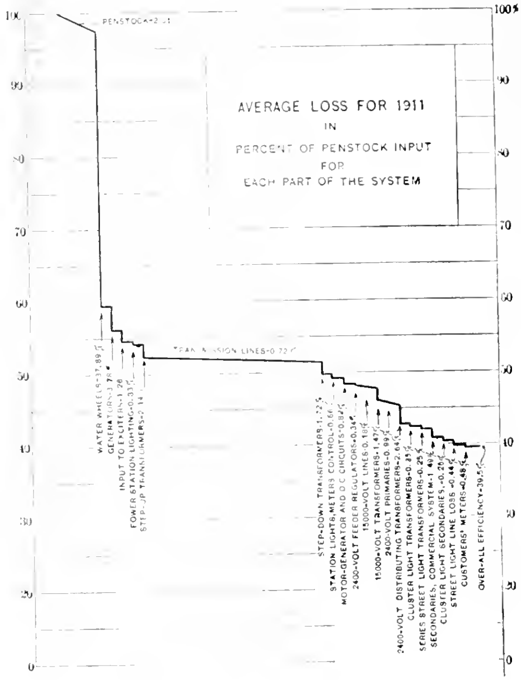
BY J. D. ROSS

The following paper is an analysis of the losses and efficiencies of the Seattle Municipal Light & Power plant for the year 1911.

Great care has been taken in these measurements and the results have been checked in as many ways as possible and instruments have been frequently calibrated. These figures are therefore believed to be a close approximation to the true values.

General Description of Plant.

The Seattle plant is a hydroelectric system delivering water to two 1500 kw. Pelton units and two 5000 kw. turbine units under 600 ft. (183 m.) head through two pipes aproximately $3\frac{1}{2}$ miles (5.6 km.) long, one of which is $67\frac{3}{4}$ (172 cm.) and the other 49 (124 cm.) inside diameter. The current is transmitted at 60,000 volts through two lines to Seattle, a distance of 38.7 miles (62.2 km.), and is there distributed at 15,000 and 2400 volts for use by approximately 20,000 customers and for the city street lighting.



OUTLINE OF LOSSES AND EFFICIENCIES FOR 1911, SEATTLE MUNICIPAL LIGHT AND POWER PLANT.

	Per cent all-day efficiency	Total 1911 input, kw-hr.	Average 1911 input, kw	Total 1911 loss, kw-hr	Average 1911 loss, kw.	Per cent loss	Per cent of penstock input	Per cent of total loss
GENERATING SYSTEM	54.4	52,639,000	6009	23,990,300	2739	45.6	45.6	75.3
Penstocks.	97.7	52,639,000	6009	1,214,900	139	2.3	2.3	3.8
Generating station	55.7	51,424,100	5870	22,775,400	2600	44.3	43.2	71.5
Water wheels.	60.7	50,758,900	5795	19,944,400	2277	39.3	37.9	62.6
Generators	93.5	30,814,500	3518	1,990,800	227	6.5	3.8	6.2
Exciters		665,200	76	665,200	76		1.3	2.1
Station lights and control.		175,000	20	175,000	20		0.3	0.5
TRANSMISSION SYSTEM	91.6	28,648,700	3270	2,413,500	276	8.4	4.6	7.6
Step up transformers.	96.1	28,648,700	3270	1,126,000	129	3.9	2.1	3.5
Transmission lines	98.6	27,522,700	3141	378,000	43	1.4	0.7	1.2
Step-down transformers.	96.6	27,144,700	3098	909,500	104	3.4	1.7	2.9
DISTRIBUTING SYSTEM	79.2	26,235,200	2994	5,448,700	622	20.8	10.3	17.1
City substation	98.7	26,235,200	2994	346,400	40	1.3	0.7	1.1
S. Lights and control.		317,400	37	317,400	37	1.2	0.6	1.0
Switchboard meters			...	29,000	3		0.1	0.1
15,000-volt system	92.5	11,587,000	1323	868,600	99	7.5	1.6	2.7
15,000-volt lines	99.2	11,587,000	1323	93,500	11	0.8	0.2	0.3
15,000-volt transformers	93.2	11,493,500	1312	775,100	88	6.8	1.5	2.4
Series street lights	86.3	2,672,800	305	367,200	42	13.7	0.7	1.2
Transformers.	95.0	2,672,800	305	133,700	15	5.0	0.3	0.4
Series circuits	90.8	2,539,100	290	233,500	27	9.2	0.4	0.7
Cluster street lights	79.1	1,486,000	170	310,000	35	20.9	0.6	1.0
Cluster transformers	87.8	1,486,000	170	181,000	21	12.2	0.3	0.6
Underground cables.	90.1	1,305,000	149	129,000	15	9.9	0.2	0.4
2400-volt commercial system	76.2	13,178,400	1612	3,123,700	357	23.8	5.9	9.8
Peeder regulators	98.6	13,178,400	1612	178,500	20	1.4	0.3	0.6
Primary feeders	96.0	12,999,900	1592	521,600	60	4.0	1.0	1.6
Transformers.	88.8	12,478,300	1532	1,391,000	159	11.2	2.6	4.4
Secondaries	92.9	11,087,300	1373	782,600	89	7.1	1.5	2.5
Customers' meters	97.6	10,304,700	1284	250,000	29	2.4	0.5	0.8
Direct-current system.	35.7	673,200	77	432,800	49	64.2	0.8	1.4
Motor-generator.	38.0	673,200	77	417,000	48	62.0	0.8	1.3
D-C. circuits	95.0	256,200	29	12,800	1	5.0	...	.
Customers' meters	98.8	243,400	28	3,000		1.2		

SUMMARY Total power loss. 31,852,500 kw-hr. Average 3,636 kw.
Total power delivered to customers 17,304,900 " " 1,975 "
Total power delivered to street lamps 3,481,600 " " 398 "
Total delivered power 20,786,500 " " 2,373 "

Over-all efficiency, 39.5 per cent.

[1 kw-hr. at the customers' premises requires 1,364 gallons (5,163 liters) of water from Cedar Lake at average head of 590 feet (179.8m.)].

PRACTICAL JOINT POLE CONSTRUCTION.

BY J. E. MACDONALD.

The object of this paper is to set forth the Los Angeles method of joint pole construction, which five years of practice has proven to be a workable scheme.

Independent operation, accompanied by very rapid development and expansion, had permitted pole conditions to become extremely objectionable to the public as well as to the corporations responsible for them. This reached a critical stage in 1906, when agitation for underground subways for all public utilities marked the beginning of the present co-operative policy. Distribution by the underground method, except in the business district, is impracticable, for the reason that the populated districts demanding service are scattered over a very wide range of territory, there being entire absence of congestion anywhere.

The problem of joint pole construction was taken up for solution by the principal companies and the result was a general agreement covering the different phases of the work as seemed best fitted for local conditions. These conditions were favorable for the consummation of the project. The old construction stood out boldly as an object lesson in dangerous and unsightly congestion. The undeveloped but rapidly growing districts offered a field for trying the proposition under favorable conditions without any complications. There were some problems in the older districts which were not so readily solved, chief of these being difficulty of eliminating the capital charges against the existing overhead system of each operating company. It is evident that if any poles are removed before the expiration of their natural life, or if wires are transferred which are providing adequate service, then a certain portion of the original investment must be absorbed in some manner in reconstructing on joint poles. This factor was given proper consideration in the preliminary investigations made in arriving at a satisfactory working agreement. A policy was adopted making the participation in such joint construction entirely optional with each company. However, when any poles are set, it is always with a view to providing space for all parties operating in such location. Even with this liberal policy, there have been but few cases where all companies have not found it to their advantage and profit to immediately join in such construction. Notwithstanding this condition, there has been no unequal division of the financial responsibilities, neither has there been any reason to suspect that the joint work has helped the financing of one project at the expense of another.

The working agreement, which was executed by nine companies operating in common territory, assigned the executive powers to a committee, acting without compensation. This committee is comprised of one representative from each member company, all representatives having similar authority regardless of the pole plant owned by the company represented. A secretary, appointed by the committee, is actively in charge of the details of the combination work. An office is maintained independently of the affiliated companies, the expense being prorated uniformly against these member companies. The committee meets monthly for the discussion of combination work, and the consideration of mutual problems. The secretary is advised of all contemplated construction and reconstruction, and plans are made accordingly to provide for the service of all companies operating in the section, where proposed construction or reconstruction is to be undertaken.

The agreement makes certain fundamental stipulations; it defines the general purpose and intention of the agreement; it places certain necessary restrictions on joint work, defining the limits of good practice; it specifies the method of operating under the agreement; the term of agreement and responsibility of each company is predetermined as far as practicable; it limits the manner of occupying and space to be occupied by each party; it fixes valuations and charges, and prescribes regulations governing special expenses and maintenance.

In addition to the foregoing fundamentals, certain general regulations, which should not be considered as arbitrary rulings, have been adopted.

1. Combined Use of Existing Poles. In the combination use of existing poles, the combining parties use the highest or most satisfactory poles in the location where it is desired to make combination. The owner of same is permitted to bill the combining parties for a proportional interest at the rate which has been fixed for the valuation of such poles.

2. Reconstruction by Owning Parties. When it is desired to reconstruct a pole line in location where none of the existing poles are suitable for combination use, one of the parties operating in this location sets new poles of standard size and length sufficient for the combination use of all parties operating in this section and for any other party which may desire to obtain space on poles. The constructing or owning party then sells a proportional interest to each party making the combination at the rate which has been fixed for the valuation of such poles. Each party transfers its wires and removes its poles at its own expense.

3. Reconstruction by New Coming Party. When the party is occupying a favorable location on any street or highway, and a second party desires to build a pole line in the same location, if the construction of the first party is entirely satisfactory and adequate for present and future needs, that party is not obliged to assume any expense in connection with the joint occupation of the new pole line built by the second party. The latter builds pole line suitable for combination use of both parties, and grants and assigns an interest in same to the first party without charge, except that the first party transfers its wires, cross arms and fixtures at its own expense from old poles to new poles. This party removes its poles at its own expense and they remain its individual property. In special cases, however, the second party may be required to pay the entire expense incident to such transfer of wires and removal of poles, and this is determined by the committee, only those participating in the decision who are directly interested in the combination.

4. New Pole Lines in Undeveloped Territory. Any party desiring to construct a new pole line in location where heretofore no pole line has existed, no-

fies the other members, through the committee, of the proposed construction, and upon request provides space on such poles for the use of all parties who express their intention of combining in their use. The constructing party is then permitted to bill each of the combining parties for a proportional interest at the rate which has been fixed for the valuation of such poles.

5. Renewing Poles Naturally Decayed. All poles which have been in use as long as the committee determines that they are safe or satisfactory, or as long as the parties owning shares in same desire to use them, are replaced by new poles. The work of constructing such new pole line is undertaken by one of the parties, as determined by the committee, and this party is permitted to bill the other parties in the same manner as specified heretofore.

6. Disposition of Joint Property Removed from Service. Joint poles removed from service may be removed at joint expense to a place designated by the committee, where they may be sold at auction, due notice having been given to each party prior to date of sale. The proceeds of the sale are divided between the owners in proportion to the number of shares owned by each. More frequently it is desirable that such poles should be sold or disposed of before being removed, the purchaser removing same at his own expense. This may be done by mutual agreement or by an exact division of the property in proportion to the shares owned by each party.

7. Use of Old Poles. In the combination use of poles, those which have previously been in service elsewhere may be used, and provided that such poles are in other respects equal to new poles, are valued at the same rate as for new poles of the same height except for that portion which has been in the ground, which is considered as of no value.

8. Records. A record map is prepared for all combinations. Poles are numbered to correspond with house numbers of adjacent property. These maps are supplements to the general agreement and furnish a complete record, specifying the number and size of poles, date when set, valuation, and such other data as may be desirable in each case. These supplements must be approved by all parties interested before any authorization for billing is permitted. A complete file of all combination work is maintained for each company by the committee.

9. Specifications. A specification is understood to imply only first class construction, and as a rule, deals with maximum and minimum quantities. Assuming, therefore, that each party is maintaining its lines in the highest state of efficiency, a joint specification is simply a summation of all specifications together with such modifications as are necessary to mutually protect the property of combining parties. This subject is so extensive that it cannot well be covered in a paper of this scope. The author would refer those seeking enlightenment along this line to the specifications adopted by the New York Telephone Company and the Public Service Corporation. This offers an excellent standard of construction, which is worthy of adoption. Local conditions will not demand any radical changes therefrom.

Progress in Los Angeles and Vicinity.

During five years of operation combinations have been recorded on 21,270 poles. By count of poles occupied by two or more parties it has been determined that the number which have been eliminated exceeds 36,000. The length of the average pole in combination use has been found to be 43.04 ft. (13.12 m.)

IRRIGATION IN THE SPOKANE VALLEY.

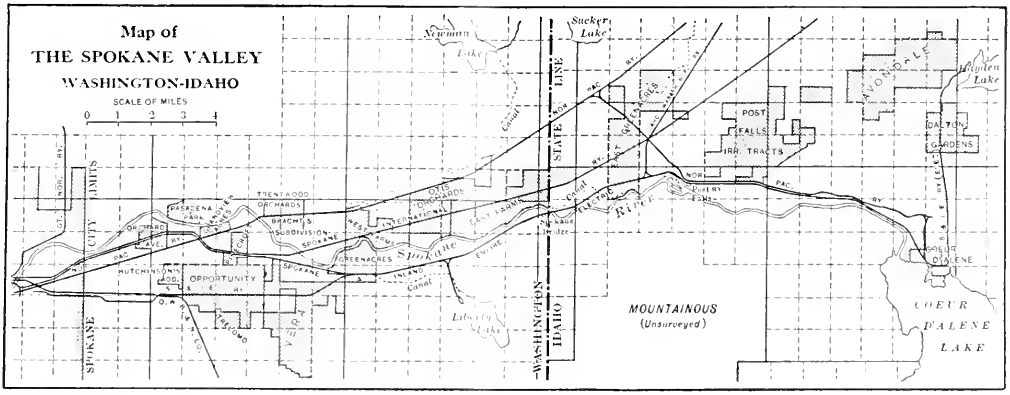
BY L. I. CORBETT

The first time I made the trip through the Spokane Valley was on a hot July afternoon nearly twelve years ago. Most of it was dry pasture land, but here and there were fields of grain, many of them already cut, bound and shocked. This seemed unusual to me for that time of the year, for in my own neighborhood, some 80 miles (128 km.) south of this, the grain would not be ready to cut for some four weeks yet. Under these conditions it looked quite dry, parched and dusty. Houses were few and far between, and the bright sun shining on the whiteness of dry grass and stubble made the tree-covered hills at each side of the valley look far more inviting.

A July traveler of 1912 will see a far different view spread before him. He will pass orchard after orchard of peach, apple and pear trees, tracts of small fruits, vegetables and melons, and will see evidence of a plentiful supply of water on every hand. Neat, well built houses are dotted about over the landscape and the appearance of comfort, sociability, and thrift is general. This change has been wrought by irrigation, either by means of gravity systems or by electrically driven pumps. This pumping load is becoming of increasing importance to the electric power companies.

The rate at present paid is $4.00 per kv-a. per month, subdivided into two fifteen day periods, based on the ten minute peak load. The irrigation load extends from May 1 to September 1; the remaining eight months the load consists of the lighting and the power for domestic water supply.

The cost of the plant in these cases is absorbed by the added value of the land. The land is sold in tracts, the unit being ten acres (4.05 hectares). With each acre of land, one share of stock in the water company is conveyed, so eventually, when the land is all sold, the owners of the land operate the water company as a mutual concern. The water contracted for is 14.4 inches (36.5 cm.) in depth in 120 days, commencing May 1. The water is to be delivered at the high point of each 10 acre (4.05-hectare) tract. The cost of operation and maintenance for the season of 1911 was about $6.50 per acre (0.405 hectare.) This does not include interest and depreciation. Exact data on the cost of these systems are not available. An average from the summary of an irrigation census, taken in 1910, places the average cost throughout the valley at $51.00 per acre. I believe that for these systems the cost would be higher than this, probably in the neighborhood of $80.00 per acre. This would include the cost of the domestic supply system, as would also the maintenance charge of $6.50 cover the cost of the domestic service. To allow for interest and depreciation, from $4.00 to $6.00 per year should



Irrigation Tracts in the Spokane Valley

be added, which would bring the power cost up to from $10.50 to $12.50 per acre per year.

To give some actual figures, on a smaller project in the vicinity with which I was personally connected, the total amount of land was 330 acres (133 hectares), of which 20 acres (8.1 hectares) was granite scenery, upon which a number of tenacious pine trees clung. The well was located on low ground, where the total depth was only 46 feet (14 m.), the last 11 feet (3.3 m.) of which was below the low water level, and lined with a perforated steel casing, five feet (1.52 m.) in diameter. A wood tank located on the rocks acted as a standpipe and reservoir for the domestic supply, the head pumped against being about 190 feet (58 m.) including friction. A flat at an elevation of 35 to 60 feet (10.6 to 18.3 meters) above the water table, and a bench at an elevation of 100 to 110 feet (30.4 to 33.5 meters), were on one side of the well, while hillsides and benches up to 150 feet (45.7 m.) were located on the other side. In this project, one pipe system only was used for both irrigation and domestic water. The large pump is a 7-inch (18 cm.) two-stage turbine type centrifugal pump rated to deliver 1200 gal. (4540 liters) per min., or 2.66 second-feet (0.81 second-meters). It is direct connected to a 100 h.p. induction motor, three-phase, 60 cycles, 440 volts. A small triplex pump of 60 gal. (227 liters) per min. capacity, geared to a 5 h.p. motor furnishes the domestic supply for the eight months of the year in which irrigation is not practiced. A tunnelled recess was necessary on one side of the well to hold the equipment. This and the well were lined with concrete. Wood stave pipe, from 4 to 10 inches (10 to 25 cm.) in diameter, was used throughout the system.

The cost in this case, counting the amount already expended, and the estimate to finish, will amount to approximately $16,000, or, distributed among the 310 acres (125 hectares), the plant cost is about $51.00 per acre.

The capacity in this case is less than in the case of the Opportunity and Vera plants before mentioned, being only one second-foot (0.3048 second meter) to 116 acres (46.9 hectares), while the average for the other systems is one second-foot to 52 acres (21 hectares) and to 32.7 acres (13.23 hectares) for Opportunity and Vera respectively. In the small system, there has been no difficulty, as yet, on account of insufficient capacity, although the condition may arise when every acre is improved, that is; may be found expedient to add more capacity, but I think not. It was laid out for 16 hours of service per day.

On account of the high head pumped against, the power bills are high, though the interest and depreciation item is lower than on the other two systems. In this case the company makes a definite yearly charge of $12.00 per acre, though the estimate of cost had been $13.00.

The relatively high charges to the water user are not so serious in this locality as they might be in a district farther removed from large centers of population. It is possible for a workingman to live out on a small tract and work in Spokane, taking advantage of the interurban car service and commutation rates. He can have all the conveniences which go with water under pressure, he can have a reasonable amount of electric light free of extra charge, and can develop his land in his spare time. It is not a hardship on him then to pay a yearly charge of $6.50 for his one acre, for his water rent alone in the city would cost him from $9.60 minimum to $15.00 per year for the same conveniences. His electric light would add another minimum of $12.00 per year if he used it. His carfare on the interurban line would not be much greater than his carfare from any home he might have in the city, and the time taken by the trip would be the same.

For a man holding and developing a large number of acres the high charge would be more serious, but such matters adjust themselves from financial considerations, the most profitable crops for the large tracts being the perishable fruits, vegetables, etc., where the nearness to market is an important item and justifies the high cost of land and water. It would be a financial mistake to put the land in hardy apples, for instance, merely because of its nearness to the city.

As will be noted from the map, the valley is only about 35 miles (56 km.) long and an average of seven miles (11.2 km.) in width, so it is evident that in time the growth of the city of Spokane will encroach upon a large portion of it. At present, however, a variety of irrigation methods are practiced, and amounts of water furnished or prices charged are not uniform.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Underground Waters

In the struggle for water developments in recent years there have arisen new and unlooked-for intricacies in formulating their legal status. No more entangling and perplexing problem has, however, arisen than that concerning the rights of owners to underground waters.

On another page of this Journal is found a masterly treatment of this subject by A. E. Chandler. The entire matter is so recent and so important that it behooves all those interested in the electrical consumption of power to post themselves thoroughly in the matter. The electrical power plant owner is interested from two standpoints. First, he may himself be interested in the underground waters with the idea of utilizing such waters for the development of power as is done in the case of the Stone Castle plant of the Pacific Light & Power Corporation near Ontario in Southern California. In this case the underground waters of San Antonio Canyon are tapped by means of an extensive tunnel and the waters utilized for power development before they are applied to irrigation.

The other cause of intense interest to the power plant owner is that of the pumping of underground waters for the irrigation of small farm tracts. Literally, millions of electrical horsepower will some day be used in the West in pumping such waters upon small tracts of land in our arid Western empire. The power plant owner should be ready to instruct the farmer as to proper legal procedure to protect the farmer in his underground water development, for upon such safe and secure protection largely depends the consumption of these enormous powers.

The present status of water right decisions in California makes it imperative for security to purchase all riparian water rights along a stream and below a storage project to insure one against possible future damage suits. Such a situation is not only alarming, but if the courts cannot soon come to the relief by more liberal interpretations a serious drawback in development may result.

The decisions relating to the legal status of underground waters seem so just, so liberal, an impetus is now given for development of underground waters on a large and extended scale. It is to be hoped that such liberality and justness in decision may soon find its place in the courts relative to water rights.

The International Engineering Congress for 1915

For two solid hours President Dunn of the American Institute of Electrical Engineers held the San Francisco Section spellbound with his recent interesting description of the good things in store and the preparations being made for the international electrical congress to be held in San Francisco in 1915. The personnel of committees appointed speaks success in itself.

Some weeks back there appeared in the columns of the Journal a copy of the memorial sent by the temporary committee in charge of the proposed international engineering congress for 1915 to the great national engineering societies. The American Institute of Electrical Engineers took immediate and posi-

tive action and has assured the other societies informally that it stood ready to join with them for the gathering of the greatest congress ever attempted. Having assumed upon its own shoulders the complete responsibility for the successful outcome of the international electrical congress, the institute has decided—and wisely, too—that it should not take the leadership in the arranging of the general engineering congress.

Local members of the American Society of Civil Engineers are feeling justly hurt over the apathy of the executive officers of their society at New York in refraining thus far from taking affirmative action in this important matter. The Panama-Pacific Exposition is to be held primarily to celebrate the completion of the greatest civil engineering project of history, and local members of the A. S. C. E. feel their society should take the lead, by all odds, in this important matter after hearing of the enthusiasm displayed by the A. I. E. E. as depicted in the address of President Dunn, then comparing this live action with the inattention of the A. S. C. E., even though their secretary did visit these parts recently, several prominent members of the A. S. C. E. were indignant, to say the least, over the slight evidently intended from the New York office.

The Pacific Coast today presents the most promising field for future growth in our great national engineering societies. It would seem a pity to have some of these Western men withdraw to form their own organizations where reasonable attention and courtesy could be expected for the needs of a growing community, but our great West is too big and too promising to allow inattention to retard its natural growth.

Load Factor

The paper submitted by J. D. Ross on "Plant Efficiency" at this week's Portland meeting of the A. I. E. E. contains many items of interest. It is the study of the efficiency of the plant as a whole which goes toward determining the dividends for the stockholders. Efficiencies can only be bettered by segregating the many details which make up the complete installation. Finally, this information together with the load factor of the system has much to do in determining an equitable basis of rates.

In order that this load factor may be determined, however, it is first necessary to have a clear and concise definition of what we mean by such a term. An important paper on "Municipal Electric Lighting Systems" by Professor C. L. Cory appeared in the columns of this publication in the issue of December 2, 1911. It was demonstrated conclusively that the load factor does play a most important role in the basis of rate fixing. For instance, it was shown in a particular case that the same return is realized from a given invested capital when power is sold at 2.57c, 3.4c or 6.32c per kw. hour, depending upon whether the load factor is 100, 70 or 35 per cent. A number of boards of supervisors as well as rate-making boards on the Coast have recently discussed this paper and it has been necessary to point out just what is meant by load factor. The term is a confusing one and should have but a single meaning.

In some quarters the load factor is taken to mean the total kilowatt hour output of a plant over a period of a year, divided by the continuous capacity of the plant over the same period. By continuous capacity is understood to be the actual power that can be generated in a hydroelectric or other generating station for the entire year. This, of course, would depend on the water situation during various months of the year. So far as rate making is concerned, this definition has no application.

Still another definition of load factor is given as that of the ratio of the total kilowatt hours output divided by the complete installed capacity expressed in similar units. This definition is not a fair one to use for rate making for two reasons. In the first place, the uniform rating of the output of electrical machinery is still such a cloudy affair that it should not be drawn into the controversy. In the second place, when it is used as the basis of rate fixing, it is positively unjust to the consumer. More than one instance has been known in which a central station has thus fixed the load factor and advised the consumer to install a certain size of apparatus, which many times proves larger than necessary and consequently makes the load factor appear unreasonably low, thereby an unreasonably high rate is charged the consumer.

To get right down to the fair basis, the load factor for each month should be defined as the ratio of the total output in kilowatt hours for the particular month, divided by the maximum load occurring during the month. In order that this definition should be perfectly clear, it is necessary to still further define the meaning of maximum load. In the famous Coeur d'Alene mining district where power is sold to such world famous producing mines as the Bunker Hill and Sullivan, the maximum load is defined as that load which has the highest peak at any time during the month of at least five minutes in duration, thus eliminating instantaneous short-circuits. The Washington Water Power Company, which supplies the power to this mine, has inaugurated a system of fines and penalties depending upon peak load conditions. The fairest method, however, for the establishment of rates seems to be to take the average of ten of the highest peaks occurring on the consumer's load chart during the month.

The question of rate fixing is becoming of vital interest both to the public and the central station manager. Upon a fair and equitable basis will largely depend the attitude of the public toward the central station. Such being the case, it behooves both the public service commission and the central station owner to approach the subject with the utmost fairness and openness.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, is at Portland and Seattle.

H. B. Squires, of Otis & Squires, is visiting the Eastern factories which his company represents on the Pacific Coast.

Robert Kuhn, secretary of the American Electric Heater Company of Detroit, was a recent San Francisco visitor.

R. D. Holabird, of the Holabird-Reynolds Company has returned to San Francisco after spending the week-end at Del Monte.

R. I. B. Cleavenger, of the Phoenix Glass Company, of Pittsburg, has gone to the Pacific Northwest after visiting San Francisco.

George H. Tontrup, general manager of the American Car Company of St. Louis, is in Southern California on a tour of the Pacific Coast.

Albert Sechrist, head of the Albert Sechrist Manufacturing Company, of Denver, has been visiting the San Francisco jobbers in electrical fixtures.

J. D. Ross, superintendent of the municipal lighting department at Seattle, recently spoke on "Power Sites" at the Seattle Municipal League luncheon.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, of Chicago, spent the past week at Portland on a business trip.

E. L. Brayton, president of the Pelton Water Wheel Company, left San Francisco for New York during the past week. He will visit the company's Eastern factory.

J. B. Lukes, who is in charge of the Stone & Webster Company's electric power interests, in Nevada, is at San Francisco from Reno, accompanied by Mrs. Lukes.

A. J. Myers, district manager for the Wagner Electric Manufacturing Company of St. Louis, has just returned to his headquarters at San Francisco from Los Angeles.

Geo. A. Dow has returned to San Francisco from England, where he obtained manufacturing rights of the Willans Diesel engine for a plant to be erected on San Francisco bay.

W. D. Ward, representing the Pelton Water Wheel Company, is on his way to Tahiti on business connected with the installation of a hydroelectric plant in the South Sea Islands.

J. W. Grady of the Faries Manufacturing Company, of Decatur, Ill., recently passed through San Francisco bound north on a Pacific Coast tour in the interests of his line of electric fixtures.

E. C. Meyers of Schenectady has joined the sales corps of the General Electric Company's San Francisco office, being attached to the railway supplies department. He is a graduate of Syracuse University.

John Kearns has been transferred from the position of division commercial superintendent of the Central Division of the Pacific Telephone & Telegraph Company, to that of general superintendent of collections.

F. F. Foster, formerly sales manager with B. F. Kierulff & Company, has opened business for himself and will handle an extensive line of electrical and industrial equipment, with headquarters at Los Angeles, Cal.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, is visiting Seattle and will later attend the annual sales conference of the Northern Electric Manufacturing Company, at Vancouver, B. C.

J. A. Balch, president of the telephone company at Honolulu, arrived at San Francisco during the past week, accompanied by Mrs. Balch. They are returning to the Hawaiian Islands after making a tour of this country.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is on his way to Japan on the steamer Mongolia. He will return on the Siberia after spending a few weeks of well-earned recreation.

Charles Mallory has resigned as an instructor in the engineering department of the University of Washington to join the Stone & Webster engineering force which is installing the Big Creek plant of the Pacific Light & Power Corporation, near Fresno, California.

Geo. A. Damon of the B. J. Arnold Company, at Los Angeles, will deliver an illustrated address on "The Fundamentals of a Comprehensive Transit Plan," at the annual public meeting of Tau Beta Pi at the University of California, on the evening of April 23, 1912.

J. W. Gilkyson, commercial superintendent of the Pacific Telephone & Telegraph Company at Los Angeles, has been transferred to San Francisco, where he will have the same title in the Central Division. Charles F. Mason, the former district superintendent, succeeds him at Los Angeles.

A. H. Babcock, chief electrical engineer of the Southern Pacific Company, left for Portland last Sunday morning in his private car, having as his guests Gano Dunn, president of the American Institute of Electrical Engineers, and Ralph W. Pope, the honorary secretary. They went north to attend the annual convention of the Institute at Portland.

W. P. L'Hommedieu and **R. F. Behan** of the Westinghouse Electric & Manufacturing Company's San Francisco office, recently addressed the association of electrical engineering and mechanical engineering students at the University of California at Berkeley. The subject was the apprenticeship system at the company's East Pittsburg works. Stereopticon views were shown.

Elam Miller, who was widely known on the Pacific Coast as commercial engineer with the Pacific Telephone & Telegraph Company, has succeeded Dr. Frank J. Jewett as transmission and protection engineer of the American Telephone & Telegraph Company, with headquarters in New York. Dr. Jewett becomes the assistant chief engineer of the Western Electric Company.

H. P. Pitts, of the new business department of the Pacific Gas & Electric Company, was the guest at the Home Industry League's luncheon at the Palace Hotel last Thursday, and he delivered an address illustrated with stereopticon views. He explained a number of the new gas and electrical devices that are being introduced by his company for use in homes and in industrial establishments.

G. W. Canney, manager of the service department of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburg, arrived at the San Francisco office of the company during the past week. He is on one of his periodical tours of the country and will spend about two weeks here for the benefit of the local branch of his department, which has to do with erection and repair work.

Sidney Sprout, engineer for the California-Oregon Power Company, has returned to San Francisco from Portland, where he secured for his company a three-year lease of the Klamath Lake Railroad. This road, which extends from Thrall, on the Southern Pacific, to Pokegawa, will be used for hauling the machinery and construction materials that are to be used at the California-Oregon Power Company's new hydroelectric development on the Klamath River about twelve miles from Thrall.

PACIFIC COAST N. E. L. A. TRAIN DE LUXE.

Arrangements are being completed for a special train de luxe for the accommodation of all Pacific Coast electrical men desiring to attend the thirty-fifth annual convention of the National Electric Light Association at Seattle, June 10-13.

The Southern Pacific Company will offer rates for the round trip of approximately $61, from Los Angeles, and $45 from San Francisco. The train from Los Angeles will leave that city on Friday evening, June 7th, reaching San Francisco on Saturday morning, June 8th, when the train will start for Seattle, arriving there Sunday evening, June 9th.

The convention will open on Monday morning and at its close the train will return to San Francisco. Accommodations may be engaged for both the going and coming trip. Reservations are now being made at the office of the Journal of Electricity, Power and Gas. To every electrical man in the West who plans to attend this convention, we will be pleased to furnish full details upon request.

SEATTLE JOVIANS.

On April 11 Mayor Cotterill addressed the Jovian Electrical League, the local branch of the Rejuvenated Sons of Jove, at a noonday luncheon at the Hotel Washington Annex, where an attendance of 125 testified to the remarkable growth that has been made in Seattle. A. S. Barlow was chairman of the entertainment committee and A. E. Knoff toastmaster. Mayor Cotterill spoke of his trip to the Hebb power site, describing the property offered to the city and its possibilities for furnishing additional power to the city. He said that from an engineering standpoint and from the standpoint of public policy Seattle should develop all the water power propositions in that vicinity in order to bring down power rates. He also said that it was possible to develop, with the present flow of water at the White River intake of the Hebb property, 25,000 continuous horsepower with but little construction work, and that with an impounding dam 10,000 horsepower could be obtained. The mayor commended the members of the order for their "get together" spirit to advance the interests of electricity.

TRADE NOTES.

The Habirshaw Wire Company announces the removal of its offices in New York City to the 27th floor of the Metropolitan Tower.

The Union Tool Company of Los Angeles has purchased from the Allis-Chalmers Company, a 500 kw. steam turbine generator set, with switchboard, etc.

The Vix Engineering Company, Mills Building, San Francisco, have been appointed the Pacific Coast representatives of the Wisconsin Engine Company and will handle their crude oil gas producers and gas engines.

The Benjamin Electric Manufacturing Company has added to its sales force Mr. A. E Lubeck who will travel in the Central States with headquarters in Chicago. They have also secured the services of Mr. Otis L. Johnson, formerly with the National Lamp Association, who will have charge of the illuminating department.

The recent monthly dinner of the principal men connected with the General Electric Company's San Francisco office, was held at the Techau Tavern, with Tracy E. Bibbins, the local manager, presiding. There was a large attendance, including most of the local men and H. E. Plank, of the Portland office. Stanley A. Walton, of the Pacific Gas & Electric Company, made a very instructive address on the operation of and results obtained from the demonstration car which his company sends all over the State to show practical application of electrical devices.

Among the recent orders received by the Westinghouse Electric & Manufacturing Company are the following: From the East Shore & Suburban Railroad, Oakland, Cal., one 1500 kw. motor-generator set, consisting of a 10,000 volt 60 cycle, synchronous motor and a 600 volt direct current generator. From Stone & Webster for the Seattle Electric Company, Seattle, Washington, two 1500 kw. motor-generator sets, delivering 250 volts. direct current for operation on a three-wire system. The motors are three-phase, 13,200 volts synchronous type. Oakland & Antioch Railroad Co., Oakland, Cal., has ordered a 750 kw. motor generator set consisting of 11,000 volt synchronous motor and a generator delivering direct current at 1300 volts. This set is of particular interest owing to the fact that it generates direct current at this high voltage.

MEETINGS OF PACIFIC COAST A. I. E. E. SECTIONS.

On Thursday evening, April 11th, the Los Angeles section of the American Institute of Electrical Engineers held a largely attended and enthusiastic meeting, the principal speaker being Mr. Gano Dunn, president of the Institute. A number of matters of importance were discussed, Mr. Dunn describing in detail the plan for a new distribution of the membership of the Institute. On Saturday, members of the section were invited by the Edison Company and the Pacific Light & Power Company to accompany Mr. Dunn on a visit to their respective steam generating plants at Long Beach and Redondo. The Pacific Electric Railway placed at their disposal an observation parlor car and at 9:15 a. m. 22 of the members and guests pulled out for Redondo. After visiting the Redondo plant, the car was run back to Watts and then down to San Pedro, where the new harbor was shown to Mr. Dunn. From here the short run to Long Beach was made and the new Edison plant was thoroughly inspected. From Long Beach the return to Los Angeles was made. A buffet lunch was provided on the car and everybody had a good time. Those present were: Messrs. Gano Dunn, J. A. Lighthipe, S. H. Anderson, R. W. Sorenson, A. Kean, Geo. A Damon, F. Dix, C. W. Koiner, E. L. Veuve, Edward Woodbury, Jas. M Gaylord, E. R. Northmore, E. R. Davis, R. H. Manahan, Jos. E. Barker, K. E. Van Kuren, Geo. L. Hoxie, Rudolph W. Van Norden, Henry S. Carhart, Leo Keller, S. J. Keese, J. E. MacDonald.

The San Francisco Section of the A. I. E. E. had the pleasantest gathering of the year on Saturday evening at Tait's Cafe in honor of Gano Dunn, president of the Institute. Forty members were present to do homage to their chief. S. B. Charters, chairman of the section, called upon C. L. Cory for a few remarks. Mr. Cory then traced the history of western power development, ending by alluding to the brilliant future ahead in the opening of the Panama Canal. S. J. Lisberger, John Martin and H. A. Lardner also spoke feelingly of western prospects. Gano Dunn and Ralph W. Pope, the venerable honorary secretary of the institute, closed the interesting series of talks. Mr. Dunn went into great detail in telling of his experiences in finally securing the international electrical congress for 1915.

The necessity of passing the amendments now before the institute was urged by Mr. Dunn, who presented convincing arguments for favorable action. With but one exception all the branches and sections of the institute, which have acted, have done so affirmatively. All western members should aid in this good cause by returning an early affirmative ballot.

The date of the April meeting of the Seattle Section has been changed to Tuesday evening, April 23d, at 8 o'clock, in the assembly room of the Chamber of Commerce, Central Building. Mr. Ralph W. Pope, honorary secretary of the institute, will be in the city that date and talk on the institute work. Mr. E. M. Hewlett's paper, "Characteristics of Protective Relays," which was published in the March Proceedings, will be taken as the subject of the meeting. Mr. J. Harisberger, of the Puget Sound Traction, Light & Power Company, will present a discussion with reference to relays on transmission lines. Mr. R. F. Monges of the General Electric Company, will discuss their application to electric drive and industrial power installations. Mr. S. C. Lindsay, of the Seattle Electric Company, will discuss the use of relays in connection with overhead and underground distribution networks. The Westinghouse Company will have an engineer present to discuss their characteristics and special adaptations.

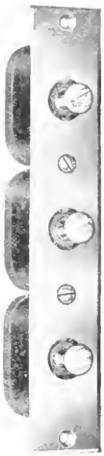
EXAMINATION FOR DRAFTSMAN.

An examination will be given at Mare Island Navy Yard on April 29th, 1912, for one second class marine engine and boiler draftsman at $4.72 per diem.

INDUSTRIAL

BATTERY SWITCHES IN GANG TANDEM.

The Cutler-Hammer Battery Switch has heretofore been furnished standard as a single switch or in gangs of two, three and four with plates to suit. However, in some cases recently there has been a desire to mount the switches one above the other and for this reason the Cutler-Hammer battery



Cutler-Hammer Battery Switches

switches are now furnished in gangs side by side and one above the other as shown in the illustration. The switches in both cases are the same, 10 ampere, 80 volt battery type arranged for push and pull operation, pushing the button opening the circuit. The frames of the individual switches are riveted to a steel connecting link. A solid flush plate, polished brass, brush brass, polished nickel or gun metal finish, is fastened with machine screws to the switches after they are installed.

AN ELECTRO-MAGNETIC AFTER-DINNER SPEAKER

As a general rule, after-dinner speeches can successfully compete with so-called sleeping powders in their slumber-producing effect, unless some novelty is brought into play or some unusually eloquent or witty speaker is heard. Either alternative is difficult to find, but it has remained for the telephone to create a new interest in "we-have-with-us-tonight" oratory.

Members of the Yale Club, residing in Chicago, recently decided to hold a dinner at the Hotel Blackstone and naturally wished to hear a personal message from President Hadley of their alma mater. As it was not convenient for the latter to attend the dinner, and the committee thought that a letter would not convey the same spirit of warmth and good cheer, it was decided to see what the long distance telephone could do to bring about the desired result. What would have been considered an utterly foolish idea a few years ago was a comparatively simple thing for the present-day telephone engineer.

As the result of special arrangements made by the Chicago Yale Club, two direct wires were connected through from President Hadley's home in New Haven, Conn., to the Hotel Blackstone, Chicago, with a telephone repeater at the latter point, in order that no word of the speaker's remarks might be lost. The diners, seated in groups of eight at small tables, listened through Western Electric watch-case receivers to a most interesting five-minute speech, beginning at about 9:17 p. m. Having finished speaking, President Hadley took up a receiver on the second or listening circuit and for over half an hour listened to the songs and cheers of the merry gathering.

To President Hadley, therefore, belongs the unique distinction of having made the longest long-distance speech on record. The vista of possibilities opened up by this achievement are enormous, to say nothing of the transportation expenses saved in bringing noted speakers to the place of meeting.

WESTINGHOUSE LOCOMOTIVES FOR THE SOUTHERN PACIFIC COMPANY.

Six direct current 60 ton Baldwin-Westinghouse electric locomotives and 20 Westinghouse car equipments with HL control have been purchased by the Southern Pacific Railroad Company for operation on the Southern Pacific and the Pacific Electric Company properties. Both the car and locomotive equipments are arranged for operation on either 600 or 1200 volts. Most of the property now operates at 600 volts, but there are portions at 1200 volts, and the double voltage equipment was selected so that it might be used on any portion of the system and on such 600 or 1200 volt extensions as may be built in the future.

The 60-ton locomotives, each of which will have an aggregate motor capacity of 1000 h.p., will be the largest 1200 volt locomotives ever built. They will have quadruple equipments of the No. 308-B-7 commutating pole motor which is a 600-1200 volt motor rated at 225 h.p. at 600 volts with natural ventilation and 250 h.p. at 600 volts with forced ventilation. This motor has all the exclusive features of Westinghouse railway motor construction, such as spider armature construction, bolted commutator, rugged brush holders and oil and waste lubrication that have made Westinghouse railway motors famous.

Because of the large capacity of the motors the duty on the control equipments will be very severe. Westinghouse HL Control which has already demonstrated its fitness for controlling motors of great capacity on the Pennsylvania locomotives will be used. Mechanical parts for the locomotives will be furnished by the Baldwin Locomotive Works. The cabs and frames will be entirely of steel.

A Westinghouse dynamotor-compressor will be used on cars and locomotives for operating the air compressor and for furnishing 600 volt current for both control and lights when the equipments is on 1200 volt sections of the line.

The 20 passenger cars will be furnished by the Pullman Palace Car Company. Each car will have quadruple equipments of Westinghouse No. 327-C Commutator pole, 50 h.p. (at 600 volts) meters and Westinghouse HL control.

TRADE NOTES.

An order for three quadruple equipments of 101 B-2 motors and K-28 B control has just been received by the Westinghouse Electric & Manufacturing Company from the Boise Railway Company, Boise, Idaho.

R. E. Starkweather, transmission line specialist is building 80 miles of double circuit steel tower line from Colton to Long Beach under contract from the Southern California Edison Company. He also has to string double circuit 0000 aluminum wire on the new 240-mile steel tower line of the Southern Sierras Power Company from Bishop Creek to San Bernardino.

NEWS NOTES

INCORPORATIONS.

LONG BEACH, CAL.—The California Co-Operative Motor Company has been organized here with a capital stock of $150,000. The company will erect a building to cost between $40,000 and $60,000. The directors are: W. H. Bennette, Joseph J. Mottell and Stephen H. Underwood.

VANCOUVER, WASH.—The Independent Electric Company, capital stock $50,000, has filed articles of incorporation. The incorporators are H. G. Fleischhauer and M. F. Brady, of Portland, and H. K. Lugger, of Vancouver. The principal place of business is Vancouver, though an office may be retained in Portland.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the El Cajon Valley Homeland Water Company, with capital stock of $15,000. J. F. Cullen, C. N. Woodworth and C. C. Tolstam are the directors. The company is formed for the purpose of acquiring the necessary rights of way for pipe lines, flume lines, aqueducts, reservoirs, and for storing and carrying water from some point on pipe lines of San Diego Flume Company to El Cajon Valley Homeland Tract.

ILLUMINATION.

OXNARD, CAL.—Oxnard has voted $100,000 bonds for a water plant and $30,000 bonds for a lighting system.

CULDESAC, Idaho.—The City Council is considering bonding the town for putting in an electric light plant and possibly taking over the waterworks system.

VALLEJO, CAL.—An ordinance is in readiness calling for an election to be held on May 15th, on the proposition to bond the city for $100,000 for a municipal light plant.

SHELTON, WASH.—The Peninsular Railway Company has been granted the right to use the streets and alleys of the town of Shelton for the purpose of transmitting heat and light within said city.

SANTA ROSA, CAL.—Notwithstanding the fact that it lost the franchise it had applied for and which was sold to Fred L. Wright, the Great Western Power Company has applied to the Supervisors for another franchise.

SPOKANE, WASH.—The Spokane, Washington Improvement Company, owners of the Rockwood addition, are opening negotiations for the installing of artistic electroliers on all the boulevards and cross streets and avenues in the addition. The improvement will represent a cost of $15,000 to $20,000.

SEATTLE, WASH.—Four bids for supplying the city lighting department with 58,000 incandescent lamps for the ensuing year were received and all were for exactly the same amount, $84,539.20. The Board of Public Works awarded the contract to the Northwest Electric & Supply Company, a local concern.

WALLA WALLA, WASH.—Bids for material for a new $30,000 gas plant in this city to be erected by the Pacific Power & Light Company, have been called for by Chief Engineer McGee, with headquarters in Portland and as soon as the various bids are submitted and passed upon actual work will be started. It is to be a two-story brick building at Sixth and Rose streets.

LINDSAY, CAL.—An application has been made to the Board of Trustees for a franchise of 50 years, for the purpose of conducting and distributing electricity and electric power for heating, lighting and power purposes in the city of Lindsay. Sealed bids will be received up to April 23, for the sale of said franchise to the highest bidder. Each bid must be accompanied by a certified check in full amount of bid, payable to the treasurer of the city.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company's earnings for three years compare as follows:

	1909	1910.	1911.
Gross	$13,491,288	$14,044,596	$14,604,609
Operating expenses	7,531,576	7,921,341	8,214,071
Net earnings	5,959,712	6,123,255	6,390,537
Bond interest	2,988,522	3,006,256	3,254,133
Balance	2,971,190	3,116,999	3,136,404

PORTERVILLE, CAL.—New officers for the Home Gas Company were elected at a meeting of the board of directors Saturday. The reorganization of the old corporation is one of the steps in the final development of the Central Counties Gas Company, now under way. New officers, as selected for the company, include: Charles S. S. Forney of Los Angeles, president; E. E. Graham, a local banker, vice-president; H. P. Landis of Los Angeles, secretary; E. J. Broberg of the Pioneer Bank of this city, treasurer, and J. H. Strades of Los Angeles, director. President Forney announced that within a week they would have an expert on the ground to reconstruct the distribution system, after which they will lay a gas main from here to Lindsay, a distance of 11 miles.

PORTLAND, ORE.—An ordinance giving the Northwestern Electric Company of Portland and San Francisco a 25-year franchise to engage in the business of distributing electricity to the people of Portland for light, heat and power purposes, has been presented to the City Council. The terms of the proposed grant provide for the payment to the city of a percentage of the company's gross earnings within the city, and specify the rates that shall be charged. The Council is given power to regulate the exercise of the franchise. It is agreed that construction work inside the city limits is to begin within one year following the passage of the ordinance and that at least 10,000 horsepower of electricity will be ready for delivery in two years. The company must deposit a $50,000 bond which shall be void after $250,000 has been expended in construction work, 20 per cent of which is to be spent in the city. The balance will be expended in the development of its hydroelectric power plants on the Klickitat, Lewis and White Salmon Rivers. If, at the end of 25 years, two-thirds of the voters elect that the city acquire the plant a sale will be made on a valuation to be fixed by arbitration. The incorporators are: Mortimer Fleishhacker, president of the Great Western Power Company, and the City Electric Company of San Francisco; Herbert Fleishhacker, president of the Anglo & London-Paris National Bank, of San Francisco, William H. Crocker, of the Crocker Real Estate Company and the Crocker National Bank, of San Francisco; Antoine Borel, of Antoine Borel & Co., San Francisco bankers; the Daniel Meyer Bank, of San Francisco, and others. The company already has started the construction of a 15,000 horsepower hydroelectric plant on the White Salmon River. Part of this energy is to be utilized to operate the Camas paper mills, which now run by steam power from oil-burning boilers. Stone & Webster have charge of all construction work and B. C. Condit is resident engineer for the company.

TRANSMISSION.

PENDLETON, ORE.—John T. Whistler, engineer, submitted his report on the power site on the Walla Walla River upon which the city has an option and which is proposed as the source of supply for a municipal power plant; $55,000 is the approximate amount which he figures would be neces-

sary for a transmission line from the power plant to Pendleton and for a distribution system for the city.

CALDWELL, IDAHO.—The interests of the old Caldwell Power Company have been taken over by the Idaho-Oregon Light & Power Company. Several minor extensions are planned by the new company.

SALEM, ORE.—The Southern Pacific has filed with the State an application to appropriate the waters of the McKenzie River at Cedar Lake. It is reported that the company will build a power plant on the site.

BAKER CITY, ORE.—J. A. Howard has been granted a franchise for the construction and maintenance of a power line from the Swan Falls plant to Mormon Basin. Several large mining companies will be furnished power.

LOS ANGELES, CAL.—The Board of Public Works has authorized preliminary steps to be taken relative to installation of a municipal power distributing system. President Hubbard and Commissioner Humphreys of the board estimate that it will cost about $25,000 to make the maps desired. At a conference it was decided that a bond issue would be necessary, but the election, it was argued, should be held in January instead of December, as first proposed.

SACRAMENTO, CAL.—The Great Western Power Company, through its attorney, appeared before Superior Judge Shields to show cause why a restraining order should not be issued by the court preventing it from operating a power plant line underneath the sidewalk in front of the Clunie building. Mrs. Florence Clunie in a suit filed recently asked for such a restraining order. The case is an important one of State-wide interest. It involves the ownership of the area underneath the sidewalk. The question has never before been raised in the State, and upon its outcome may depend similar actions all over California.

FRESNO, CAL.—A complete appraisal of the physical property of the San Joaquin Light & Power Company will be made by J. G. White & Co., Inc., of New York and San Francisco. Beginning on April 15 the work of valuing the properties of this big public utility corporation will extend over a period of several months and engage the attention of a staff of 35 to 40 engineers and real estate experts. The work will be under the general direction of J. C. Gillespie, manager of the valuation department of J. G. White & Co. on the Coast, who will open a temporary office in Fresno for the convenience of the field force.

SALEM, ORE.—Power development, for which it is estimated $5,149,515 will be expended, is represented in filings allowed by the State Engineer's office, according to an abstract just completed by State Engineer Lewis. The office has issued 121 permits representing a total of 116,340 horsepower, or an average of 922 horsepower for each filing. The largest filing shown by the abstract was made by W. K. Brown, on the Klamath River, for 20,000 horsepower. The next largest filing was by the Willamette Power Company, of Portland, on the North Fork of the Santiam River. These two represent 10,200 horsepower. F. P. Donovan of Payette, Idaho, asks for 1200 cubic second feet from the Clackamas River between Oregon City and Portland. It is presumed he intends to develop power for use in Portland, as the application says that it will be used for power, manufacturing and municipal purposes. According to application, the cost of developing power will be $1,250,000. It is intended to develop 15,000 horsepower and construct two pipe lines five and one-fourth miles long. Fees amounting to $818 were paid by Donovan.

TRANSPORTATION.

NORTH YAKIMA, WASH.—It is reported that the Kittitas Railway & Power Company, now constructing a line from Cle Elum to Roslyn, will extend the line here.

KALISPELL, MONT.—The Flathead Interurban Railway Company has made application for a franchise to use certain of the streets in Kalispell for a street railway system.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway Company will soon make a tentative survey for an extension on from here to Delta. It is believed the road will be built shortly.

TULARE, CAL.—David Oliver Jr., and H. W. Coffin, both of San Francisco, have announced that they are preparing to take up the construction of the Porterville-Tulare Electric Railroad, which has been under discussion for the past half a dozen years.

SACRAMENTO, CAL.—Because of the increased traffic between Stockton and Sacramento the Central California Traction Company has determined hereafter to run two-car trains between the capital and the channel city. Heretofore single interurban cars have been on the run. The two-car trains will be a permanent thing after next Sunday.

SACRAMENTO, CAL.—The Central California Traction Company, which runs an electric line from Stockton to Sacramento, has appeared before the State Railroad Commission, through its attorneys, pleading for an order commanding the Santa Fe road to establish with it joint rates, through, and local, passenger and freight. Because of the insufficiency of the evidence as submitted and in order to give attorneys for both sides longer time to prepare additional evidence in the case, the hearing was postponed until April 26.

SAN FRANCISCO, CAL.—The last $400,000 of 4½ per cent Geary street railway bonds have been sold to Adams & Company of Boston, for $402,064 and accrued interest. The city received a premium of $2064 on the block. Adams & Company's bid was submitted through the Bank of California. The bid was authorized by a certified check for $10,000 from the bank. One other bid was received, this being the offer of Vincent D. McDevitt of this city to purchase one $1000 bond at par. Delivery of the bonds will be made immediately.

LOS ANGELES, CAL.—The steel gang of the Pacific Electric Railway Company which is broad-gauging the old interurban line, has completed the track to the planing mill of the San Pedro Lumber Company. Work of resurfacing the track up to this point now will be taken up. About two weeks later an extension of the broad-gauge track will be made into the business district. It is likely that this will be done by following the low ground north of Nob Hill through an intersection with a line from Dominguez. The route will be double-tracked south from Athens at an early date.

SAN FRANCISCO, CAL.—New bids for the construction of the Geary street road from Fifth avenue to Kearny street have been asked by the Board of Public Works. Spurred on by the Mayor, the commissioners have decided to go ahead with the Geary street road work as rapidly as possible and will open bids next Wednesday afternoon. Bates, Borland & Ayer, who submitted the lowest bid for the road building and who were awarded the contract but have refused to enter into an agreement with the Board of Public Works, are seeking to restrain the board from declaring forfeited their certified check for $25,000.

VISALIA, CAL.—The Tidewater & Southern Railway, now in course of construction, between Stockton and Turlock, is to be extended through the Alta section of Dinuba to Visalia. The new electric railway is under contract to be in operation into Turlock by July 1 and into Fresno by January 1, 1913, so that Visalia is expecting to see trains running to this city in less than a year. It is the plan of the road to run from Fresno south through Selma to Dinuba, thence through Orosi and Yettem to Visalia, and from this city south to Tulare, thence east to Lindsay and Porterville and south to Bakersfield, the present terminus.

MARYSVILLE, CAL.—Work is progressing satisfactorily on the construction of the Northern Electric's branch road from Marysville to Colusa, and representatives of the company declare that at the present rate of progress cars will be running into Colusa before the end of the year. Already much of the grading has been done between Terra Buena, which will be the junction with the main line, and Meridian. Four grading camps have been established along this section. The work in the vicinity of Sutter City has been completed, and on Saturday night the camp moved farther toward the Sacramento River.

SAN FRANCISCO, CAL.—That the United Railroads Company is about to erect a building at the corner of Market and Valencia streets, was vouched for Monday in connection with the announcement of the sale of real estate in the same block facing Market street. This information was to the effect that the company will build a structure of three stories, covering a large area. The ground floor is to be designed for a street railway terminal, into which several lines will converge, so that it will be similar in several respects to the Pacific Electric terminal building in Los Angeles. The second story will be used for offices of the corporation, and the third floor for club-rooms for the employes. It was said that upon the strength of this report the contiguous real property was purchased as an investment at a price approximating $1000 a front foot, the frontage being 81 feet, and the price, including commissions, $85,000.

TELEPHONE AND TELEGRAPH.

UKIAH CITY, CAL.—Jerry Lierly has been granted permission to erect and maintain a telephone line.

ALTURAS, CAL.—The Leland & Myers Corporation have been granted permission to construct and maintain a system of telephones from Alturas to Round Valley.

SANTA MONICA, CAL.—The Pacific Telephone Company will start work within 30 days on an $18,000 job of laying a cable from city city to Venice, to carry wires.

MENDOCINO, CAL.—A franchise has been granted F. M. Weber and Dr. Peirsol for a telephone line from this place to East Mendocino and it is the intention to put in the line in the near future.

SAN FRANCISCO, CAL.—Three affidavits have been filed with the Superior Judge by Attorneys Crist and Johnson in support of their contention that the Bay Cities Home Telephone Co. and Pacific Telephone & Telegraph Co. were violating the terms of the restraining order temporarily granted by Judge Lawlor forbidding the dismantling of the phones and apparatus of the Home Company. One of the affidavits was filed to refute the claim that O. L. Scott, plaintiff in the injunction matter was in arrears to the telephone company in the payment for phone rentals. Lewis W. Ross, an affiant, declares that subsequent to March 23 there were 65 Home telephones disconnected, and appends to his affidavit a list of the subscribers whose phones he alleges were disconnected.

WATERWORKS.

MONMOUTH, ORE.—Bids will be received up to the 4th day of May, for furnishing the material and labor for constructing a system of waterworks.

OXNARD, CAL.—By a vote of 4 to 1 citizens of Oxnard authorized a bond issue of $130,000; the fund is to be divided, $100,000 going to the water plant and $30,000 for a municipal lighting system.

LOS ANGELES, CAL.—Construction work on the new plant in connection with the Mutual Water Company, which is to supply water to half-acre subdivisions on the Cudahy ranch, will be started at once.

AUBURN, CAL.—If Auburn's water consumers will agree to the meter system and reduce their water consumption from 750 gallons per day per capita to 150, the Pacific Gas & Electric Company, according to H. P. Lensomo, will install a $70,000 filter system.

SANTA BARBARA, CAL.—A resolution has been drawn ordering the sale of waterworks extension tunnel bonds in the amount of $39,000, thirty-nine in number, of $1000 each, bearing 4½ per cent interest, payable semi-annually. Bids for the bonds will be received up to 8 o'clock, May 2, and must be accompanied by a certified check of $1000.

OAKLAND, CAL.—City Water Expert J. H. Dockweiler has filed with the City Council his bi-monthly report of the operations of the People's Water Company during the months of January and February. The report shows the following: Disbursements—Expenses, $40,651.21; supply, $4721.39; distribution, $11,762.50; maintenance, $2788.78; renewal, $151.23; general expenses, $16,033.18; service construction, $2187.83. Investment—Construction account, $8347.96.

RIDDLE, ORE.—The contract for the city's new water system has been awarded to Kibbe-Welton Co., a Portland firm, for $11,454.58. The water supply is to be brought from Wilson Creek, about 3½ miles to a reinforced concrete reservoir of 100,000 gallons capacity. The concrete dam is to be placed in Wilson Creek at the intake. The engineering work is to be done by C. C. Boyer and Frank Cain of this city.

ALTURAS, CAL.—Officials of the newly-organized Modoc Irrigation Company have arrived here to prepare for the tapping of Cowhead lake, which will furnish power and light for the towns of this county and also irrigate thousands of arid acres in the famous Surprise valley. The project involves an expenditure of $500,000 and the promoters claim it will be one of the most profitable enterprises in the State. Eventually a broad-gauge railroad will be built into the valley.

OAKLAND, CAL.—In accordance with the provisions of the city charter and the repeated demands of the City Council, the Union Water Company has filed its report with the city clerk. It shows the following properties in actual use for water distribution in Oakland: Plants at Toler Heights valued at $3500; Fremont Heights, $1000; Stonehurst, $1000, Elmhurst, $8000. Total number of meters paying $1.50 minimum rate, 421; supplied 292,952 cubic feet last year. Total pumpage, 52,820,074 gallons last year. Total services, 1380. Total number of meters in use, 1379.

SALEM, ORE.—Presumably for the purpose of securing power to electrify the main and west side lines in this State, the Southern Pacific Railway Company has filed with State Engineer Lewis an application to appropriate the waters of the McKenzie River. The application calls for the appropriation of 100 cu. ft. per second and the diversion of the water of Clear Lake through a canal 4½ miles long, generating 36,136 theoretical horsepower, utilizing a fall of 795 ft. The dam is to be 31 ft. high, costing approximately $85,000 and the total cost is estimated at $1,600,000.

RED BLUFF, CAL.—The estimate made by City Engineer W. F. Luning for a complete water system for the city of Red Bluff places the cost at $85,325. This estimate was made upon instructions given the city engineer at the February meeting of the board to make an estimate of the cost of such a plant. At the same time the engineer was instructed to make an estimate of the cost of installing a lighting system for the city. Mr. Luning reports that the cost of the lighting plant, including water rights, power and everything else necessary, will be $146,668. The water plant of the Antelope Water Company, which now furnishes the town with water, is offered by the company to the city for $123,000, or for a sum $37,675 in excess of the sum that the new and modern plant is estimated to cost.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

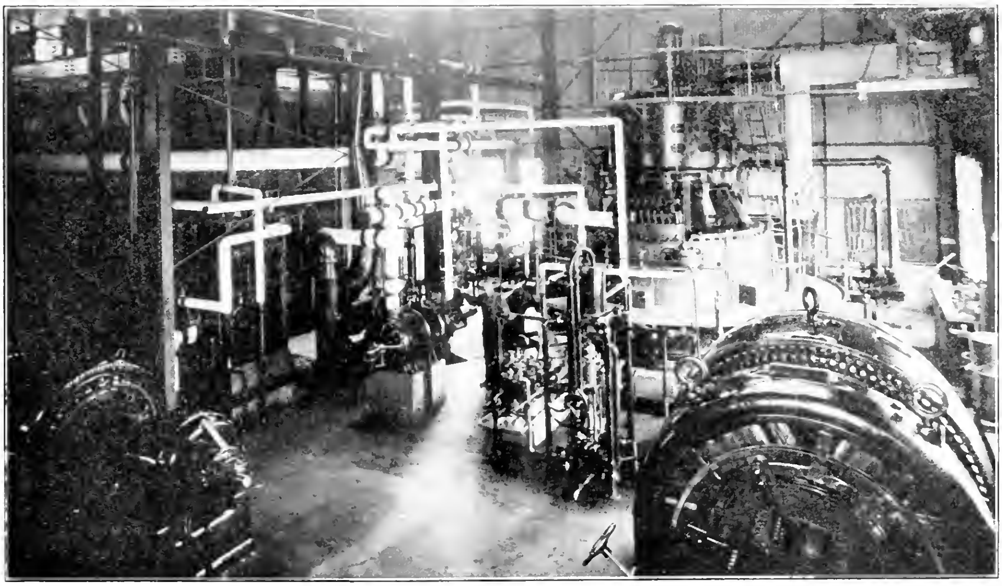
VOLUME XXVIII | SAN FRANCISCO, APRIL 27, 1912 | NUMBER 17

WESTERN STATES GAS & ELECTRIC CO. AT STOCKTON

BY ROBERT SIBLEY.

The City of Stockton, one of the oldest municipalities in the great commonwealth of California, has had an interesting history. The development of the public service corporations, supplying heat and light to its citizens, composes no insignificant part of the life of this city.

In 1905 the American River Electric Company came into Stockton, having installed an hydroelectric plant on the American River about seven miles to the northeast of Placerville. In addition to this hydroelectric plant, with its 3000 kw. installed output, that company also built a steam plant in Stockton. This



Interior of Stockton Steam Plant.

Natural gas was discovered in the underlying strata in and about Stockton some forty-five years ago. In 1887 the corporation at that time controlling the supply of natural gas in and around Stockton, also went into the electrical business under the name of the Stockton Gas, Light & Heat Company. This corporation existed until 1904 when the Stockton Gas & Electric Corporation was organized, which absorbed the old holdings of the Stockton Gas, Light & Heat Company and also purchased additional natural gas wells in and about Stockton.

steam auxiliary was installed in 1907 and the 1500 kw. vertical turbine at that time installed was the second to be shipped to California.

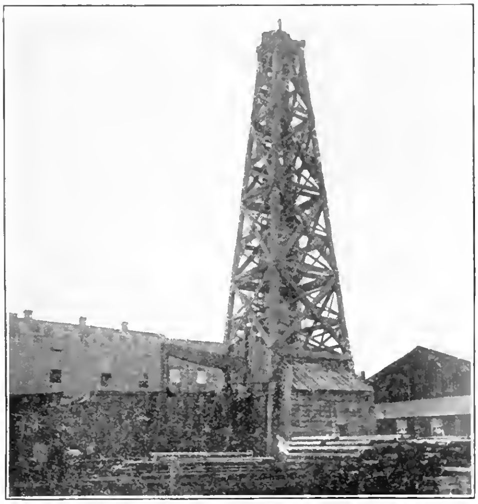
In 1910 the controlling interest in the American River Electric Company and the Stockton Gas & Electric Corporation was taken over by the H. M. Byllesby Company of Chicago. This company reorganized the separate holdings under one head and called the combined interests the Western States Gas & Electric Company. The early days of the gas and electric business in Stockton were fraught with many

dissensions and much unfavorable public opinion. In the following lines will be found a detailed description of the present holdings of the Western States Gas & Electric Company, which today are held in remarkably high public favor, for deep appreciation is felt over the broad ideals which have been instituted under the new management of the past year and a half.

Gas Plant Data.

Twelve natural gas wells are owned by the company. These wells have an output of 330,000 cu. ft. for every twenty-four hours, and, in addition to this there is manufactured at Station A of the company 300,000 cu. ft. of oil gas.

Gas well No. 8 presents an interesting picture. This well was started on November 10, 1904, and at one time was abandoned but today it is being sunk to a depth of over 2800 feet and, from the blue shale indications now being uncovered, the 8¼ in. casing of this well will soon again be pouring out its blessing of natural flow of gas.



Gas Well No. 8.

The gas plant, which is known as Station A, is being overhauled and within the next month or two will be equipped with modern devices in every particular. The new plant will contain the two old generators, reset with a capacity of 300,000 cu. ft. per twenty hours each, and, in addition, there is being installed a new Jones gas set with a capacity of 750,000 cu. ft. per twenty hours run. A place is being left in this building for another Jones set of larger proportions.

It is interesting to follow in detail the gas manufacture under the improved methods proposed. A total of 90 gallons of oil is used per charge. In the first place 15 gallons are burned in the primary generator to heat the gas set to a sufficient temperature to generate the gas. The air draft is then closed and the additional 75 gallons, known as the make-oil, is sprayed into the heated generator. The heated oil being now in a gaseous state, passes through the generator and superheater as a fixed gas on its way to the wash box. This box is kept under a constant and even water pressure. The water passing through the wash box is kept in a turbulent state so that the lampblack, deposited from the cooling gas as it journeys downward through the water, is carried off with the constantly outgoing water. Hence the washer is a self-cleaning device and is remarkable for its high efficiency. The gas next passes through vertical scrubbers containing wooden trays, placed horizontally one above the other in checkerboard arrangement. Cold water trickles down over this wooden surface and the warm gas journeying upward, coming in contact with these wet surfaces becomes cool and deposits tar and, in addition, the lampblack held in suspension is also carried downward with the trickling water. This water with its lampblack and tar burden is carried on outward to settling tanks in which practically the entire amount of lampblack and tar is recovered and then used as fuel in the plant.

Dam of South Fork of American River.

After passing through scrubbers which are 72 ft. x 30 in. in the new installation, the gas passes to the relief holders and is taken through a Root exhauster and thence forced into doubledeck purifiers 18 ft. in diameter and 12 ft. high. These two purifiers each have a capacity of 750,000 cu. ft. and additional space is left for two future purifiers of similar capacity. These purifiers contain iron borings mixed with shavings. As the gas works itself up through this oxide, the sulphur combines with the iron and consequently the gas is left practically free from this injurious content.

After leaving the purifiers, the gas passes through a 12 ft. station meter which is situated in a steel frame meter house covered with corrugated galvanized iron. Thence the gas journeys into the new gas holder which has a capacity of 750,000 cu. ft. The present holder has but a capacity of 60,000 cu. ft. The natural gas from the twelve wells is stored in a holder, having a capacity of 180,000 cu. ft. Both the natural and oil gas are taken through a Connersville booster, which forces the pressure of the gas supply to proper heights for economic distribution through the city of Stockton.

In manufacturing the oil gas, ten minutes is allowed for heating the charge and ten minutes for the manufacture of the gas, hence three charges are made per hour.

American River Power House.

Hydroelectric Plant.

The hydroelectric plant is situated on the south fork of the American River. A concrete dam, 165 ft. along the crest and 40 ft. high diverts the water into a canal. This canal has 4.9 miles of flume, 6 x 5 ft., and 2.1 miles of ditch. From the pen stock, which is 580 ft. above the power house, two combined steel-wood pipes, 30 in. in diameter and 900 ft. long, deliver the water to two hydraulic units which have Doble wheels and Pelton cases. The wheels are of the impulse type. The power house is of concrete construction with steel roof and measures 34 x 80 ft. A Cyclops crane of 20 ton capacity conveniently handles any of the installed apparatus.

Two 1500 kw. Westinghouse generators furnish three-phase current at 2000 volts, which is stepped up by means of a star and delta connection to 55,000 volts for its transmission into Stockton. Lombard governors perform the function of controlling steady operation.

The transformer room is in a concrete building adjacent to the power house, which measures 24 x 40 ft. In this is to be found three 1500 kw. Westinghouse, oil insulated water-cooled, 2000-55,000 volt transformers. There are also two similar 625 kw. spare transformers.

Two 75 kw. exciter units, installed in the main power house, supply ample excitation for the generators. These exciters are impelled by individual Pelton wheels which are supplied from the main penstock pipes.

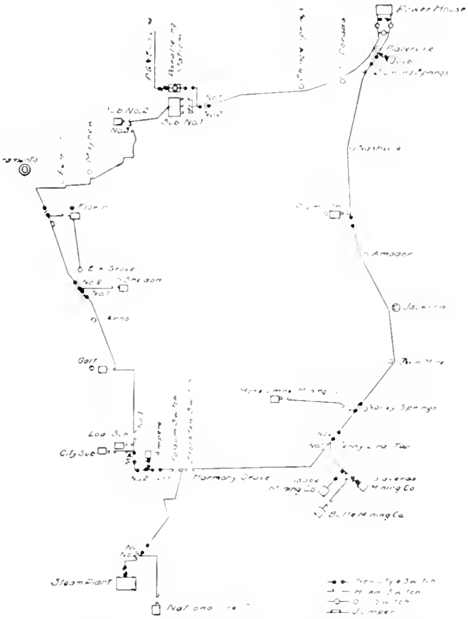
The transmission line is of No. 1 stranded aluminum wire, with the exception of a small portion of the Folsom line between the power house and substation No. 1, which consists of No. 4 copper wire.

The attendants at the hydroelectric plant live at a boarding house owned by the company and managed by the local superintendent of the plant.

Oil circuit breakers are installed on each phase of the transmission line. They are of the Thompson type and are manufactured by the Pacific Electric & Manufacturing Company.

As shown in the illustration there are two high-tension transmission systems emanating from the power house. One branch is known as the Folsom line and the other as the Stockton. Although these two lines are not tied in one with the other, as shown on the map, as a rule, the load on each circuit is well balanced. On the Folsom circuit, 40 per cent of the entire output of the system is used for four large gold dredges owned by the Natomas Consolidated Mining Company, and one by the Ashburton. One-tenth of the output of the system is used to supply the towns of Lodi, Galt, Florin, and other municipalities along the line.

The Stockton line supplies the city of Stockton and operates three gold dredges at Jennie Lind. In addition to this power consumption, two gold mines known as the Alpine Gold Mining Company and the

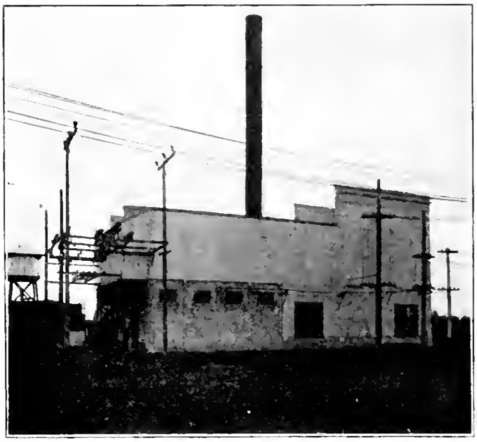


Map of Western States Gas & Electric Co.'s Transmission Lines.

California Exploration Company, are supplied at Plymouth, as well as two gold mines at Placerville. Convenient switches are installed as indicated on the map. In case of an accident these allow of a remarkable pliability and continuity of service to that portion of the line not impaired.

Physical connections are made with the Pacific Gas & Electric Company at two points, one at Substation No. 1 at Natoma and the other at Stockton. Within the next few months physical connection will be made with the Sierra & San Francisco lines which pass within striking distance of Stockton. With such a meshwork as this the Western States Gas & Electric Company is assured of perfect continuity of service.

Wooden poles are used in the transmission system and the insulators are of the four-part Victor type, tested to 100,000 volts. The wires are 6 ft. apart, spaced in an equilateral triangle with the upper apex represented by the insulator on the top of the pole. The complete transmission system comprises about 200 miles of 55,000 volt line.



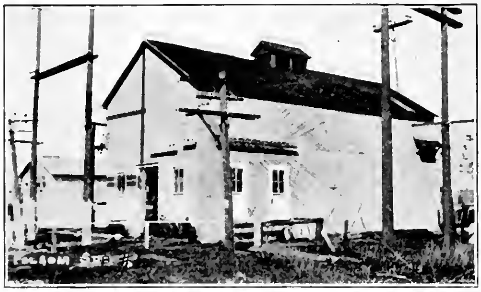
Folsom Substation No. 1, Also Showing Pacific Gas & Electric Company's Paralleling Station.

The plant formerly owned by the old Stockton Gas & Electric Company has been converted into what is now known as Station A. In addition to the principal gas works which are located at this point, there is also installed a 400 kw., 600 volt, 667 ampere, 500 r.p.m., direct current Westinghouse motor generator set. This current is sold to the local electric railway system of Stockton, the Stockton Electric Railway Company. There are also located here two 150 kw. direct current Westinghouse generator sets which are driven by a 200 kw. General Electric synchronous motor. These latter sets are used for elevator service. This station is also used as a distributing substation. In order to handle the voltage properly, three 750 kw. Stanley electric transformers are here installed.

Station B constitutes the main substation for the long distance transmission line and contains the steam auxiliary. There are installed here three Babcock & Wilcox boilers, which, on the basis of 10 sq. ft. of heating surface per h.p., have each a rating of 402.3 h.p. C. C. Moore oil burners, of the back fire type, efficiently supply heat to the Peabody furnaces. The oil is pumped by means of the 6 x 4 x 6 in. Worthington oil pumps. Oil is stored in a 2500 bbl. steel tank which is situated within a safe distance of the main building and has pipe connections to the main tanks of the Standard and Associated Oil Companies.

The main building, housing the boiler and turbine installation, is 60 x 80 ft. with corrugated iron roofing and concrete foundation. The stack is 105 ft. high, 66 inches in diameter and is of steel. A 2 in. centrifugal, motor-driven pump supplies water for the cooling of the transformers and the make-up water for boilers, pumping from a well 135 ft. deep with a 7 in. bore. Thus the company has its own individual water supply. A connection, however, is made to the city mains, for emergency. A 9000 gallon wooden tank reservoirs sufficient water for ordinary operating conditions.

The main power generated in this station is supplied from a 1500 kw. vertical Curtis turbine which



Exterior of Stockton Steam Plant.

operates under 175 lb. gauge pressure, 28½ in. vacuum. A Sturtevant blower, driven by a 15 h.p. motor, supplies forced draft for the generator, and, under these conditions, it is found a 2000 kw. load can be continuously maintained. A 35 kw. Curtis turbine generator set and also a 35 kw. motor driven set constitute the exciters.

The condenser has 6000 sq. ft. of condensing surface. It is of the Worthington type and the same make is also represented in the dry vacuum pump which is 8 x 16 x 12 in. A two-stage Worthington 2½ in. pump, driven by a 10 h.p., General Electric three-phase motor, acts as a wet vacuum pump in pumping the condensate from the hotwell into the heater. A 14 in. circulating pump is steam driven by an 8 x 12 in. Blake engine.

The step-bearing pressure, which is maintained at 700 lb., is supplied by either of two 6 x 2⅛ x 6 in. Worthington pumps. The usual type of baffler is installed to vary the pressure. Two Worthington feed pumps of the Admiralty type, 9 x 6 x 10 in. are utilized in the feed-water supply. This water is heated by a 1000 h.p. Cochrane feed water heater. A 20-ton traveling crane, manufactured by the Cyclops Iron Works, is installed in the station to lift the heavy apparatus.

The switchboard apparatus is of the General Electric standard construction so far as the alternating current installation is concerned. On the other hand the direct current supply is measured by the Westinghouse switchboard instruments.

This station is used as a distributing point in addition to its function of supplying auxiliary power to the main high tension system. Three 1000 kw. General Electric, oil-insulated, water-cooled transformers

maintain the proper 55,000-2200-volt relations. There are also three 275 kw. General Electric, oil-insulated, water-cooled transformers, having the same ratio of transformation. The company supplies considerable power to the Central California Traction Company, which operates an interurban system between the cities of Stockton and Sacramento.

In this station there are to be found a motor generator set, consisting of two 300 kw., 600-volt, 500-ampere direct current Westinghouse generators, directly connected to a 720 h.p., 2300 volt, 60 cycle three-phase Westinghouse synchronous motor. A 60 h.p. induction motor operating at 900 r.p.m., 2300 volts, 60 cycles, is also directly connected to this mechanism and is used as a starting device. This set supplies either 600 or 1200 volts.

Power is also supplied to the Central Traction Company's local lines in Stockton. This is accomplished by means of 400 kw. 600-volt, direct current, Westinghouse generator, directly connected to a 585 h.p. 2200 volt, 500 r.p.m., three-phase, Westinghouse induction motor. Both Station A and Station B may be supplied with energy from the Pacific Gas & Electric Company's lines, the American River station, and soon the Sierra & San Francisco Power Company.

The management have instituted a policy looking toward the improvement of service in every particular. Especially is this true in their efforts to decrease complaints and increase the general usefulness and efficiency of the system. To this end automobiles have been purchased to be ready to answer complaints at all hours of the day and night. A brick garage has been built to house the automobile equipment. This equipment consists of one 2-ton Gramm gas truck, two Reo 1500 lb. gas trucks, one 1-ton electric truck, one 750 lb. electric truck, one 40 h.p. Stoddard-Dayton touring car, and two 20 h.p. Maxwell automobiles.

In its relationship with the mother company, the H. M. Byllesby Company of Chicago, this system presents an interesting illustration of the efficient and close organization maintained. Full and complete managerial reports are sent to the home office each week, including a news letter. This information enables the Chicago office to keep in the closest touch with its subsidiary ownings.

The Western States Gas & Electric Company also controls extensive interests at Richmond and Eureka in California, a complete description of which will appear in later issues of the Journal.

RECENT LEGAL DECISIONS.

When a street car is overloaded and a passenger in attempting to alight gets thrown off the left side of the car and is severely injured the company is responsible for the accident, holds the court in affirming Judge Mitchell Gillian., in King county, Wash., who allowed a $6500 verdict in favor of William J. Elliott to stand against the Seattle, Renton & Southern Ry.

When a lineman climbs a pole and falls because of a defective spot in the wood, the company cannot be held responsible, says the Washington Supreme Court in reversing the Spokane Superior Court in the case of Clyde H. Hood against the Pacific Telephone & Telegraph Company, appellant.

ELECTRIC POWER IN THE MANUFACTURING INDUSTRY ON THE PACIFIC COAST.

E. Dana Durand, director of the United States Census, has thus summarized the industrial application of the Pacific Coast for one of the leading bonding houses:

There are several causes which go to explain the rapid development of manufactures on the Pacific Coast during the past ten years. Two of these causes, namely, the greatly increased use of petroleum fuel and the greatly increased development of hydro-electric power, deserve somewhat detailed consideration. Among other causes which may be incidentally mentioned are the rapid growth of population on the Coast, increasing the demand for manufactured products; the development of agricultural industry, increasing the supply of raw materials; and the advance in the price of lumber throughout the country, resulting in an increased demand for that product from the Pacific Coast States.

At one time the lack of adequate supplies of local coal was considered as a permanent bar to the extensive development of manufacturing industry on the Pacific Coast. The conditions have now been entirely changed, partly by the discovery of considerable supplies of coal on the North Pacific Coast, but much more by the discovery of enormous quantities of petroleum and by improvements in electric transmission, which make possible the economical utilization of the magnificent water powers of the Coast States. In no other section of the country are there so many lofty mountains, with attendant water power, in close proximity to the sea coast and to broad fertile areas. There seems now to be nothing in the way of an almost unlimited development of those industries which require power.

In 1900 the production of crude petroleum in California amounted to 4,324,000 barrels; in 1910 it was no less than 73,011,000 barrels. California now produces 35 per cent of the total petroleum output of the country. Three and one-half barrels of average petroleum are the equivalent of a ton of average coal as fuel, so that the California output of petroleum in 1910 may be considered as the equivalent substantially of 21,000,000 tons of coal. When it is recalled that the total coal production of the United States is only about 400,000,000 tons, the relative magnitude of this petroleum supply is obvious. Petroleum is now by all odds the most important fuel on the Pacific Coast. It is utilized in enormous quantities on the railroads, and even for the fuel of vessels. In manufacturing industries it is the predominant fuel, particularly in California.

The following statement shows the consumption of different kinds of fuel in the manufacturing industries of the Pacific Coast in 1909:

Statistics of Fuel Reported for Manufactures in Pacific Coast States, 1909.

Kind of fuel	Total	Washington	Oregon	California
Coal:				
Anthracite (long tons).......	11,151	6,268	462	4,421
Bituminous (short tons).....	478,789	417,466	18,158	43,165
Coke (short tons)..........	166,893	47,420	5,808	113,665
Wood (cords)	413,812	220,727	116,762	76,323
Oil (including gasoline) (bbls).	10,157,088	674,952	599,121	8,883,015
Equivalent approximately to coal (short tons).......	2,902,000	193,000	171,000	2,538,000
Gas (1,000 feet)...........	418,484	90,115	25,821	302,548

The fuel oil consumed in California manufacturing industries in 1909 was no less than 8,883,015 barrels, or the equivalent of more than 2,500,000 tons of coal, while the total consumption of coal and coke in the same industries was only about 160,000 tons. In Oregon also oil contributes a much larger proportion of fuel to manufacturing industry than coal. Only in Washington does coal outrank oil as a fuel. On the Pacific Coast, as a whole, the consumption of oil as fuel in manufacturing establishments in 1909 amounted to 10,157,088 barrels, or the equivalent of over 2,900,000 tons of coal, while the total consumption of coal itself, including coke, was only 657,000 tons.

It should be noted that there is a considerable consumption also of wood as fuel for manufacturing establishments. A large proportion of this is the waste product of lumber mills. In fact, it is doubtful whether the wood reported as fuel by lumber mills represents the total quantity consumed by them.

Electric Power in Manufactures.

It is impossible to State precisely how much hydroelectric power is utilized in manufacturing industries of the Pacific Coast, but the available statistics make clear the great and increasing importance of such power in manufacturing industry, as well as in public lighting and the operation of street railways. The census schedule of manufactures calls for the horsepower of water wheels owned by manufacturing establishments themselves, and also for the horsepower of electric motors in manufacturing establishments which are operated by current purchased from outside concerns. The returns do not, however, indicate what part of the power generated by water wheels owned by manufacturing establishments is converted into electric power, nor do they indicate what part of the electric power rented from outside concerns is generated by water wheels. It is a well-known fact, however, that the larger part of the rented electric current is generated by water wheels.

The following table shows, for each of the Pacific Coast States, for 1899 and 1909, the horsepower of the several classes of primary engines or motors owned by manufacturing establishments, and also the horsepower of the motors in such establishments which are operated by rented electric current. A separate item shows the horsepower of motors operated by electricity generated by the primary engines owned by the manufacturing establishments themselves; this latter item, of course, is not added into the total, as it would involve duplication, but the horsepower of motors run by rented electric current is included in the total power utilized by manufacturing establishments.

This table shows that in 1909 the horsepower of motors run by rented electric current represented over one-fifth of the total horsepower employed in manufactures, 162,299 out of 802,016. In California the proportion was over 35 per cent. In the factories of that State the horsepower of motors using rented electric current is three-fifths as great as the horsepower of the steam engines owned by such factories. On the Coast as a whole, in addition to the 162,299 horsepower of motors run by rented electric current, the motors run by current generated by the manufacturing establishments themselves have 45,802 horsepower, or a grand total of over 208,000 electric horsepower in factories.

Particularly remarkable is the increase in the use of electric power in factories on the Coast. The horsepower of motors operated by rented electric current increased from 14,428 in 1899 to 162,299 in 1909, or more than eleven-fold. The horsepower of steam engines owned by manufacturing establishments in the meantime multiplied only about two and one-half times. The horse power of motors operated by rented electric current in California increased during the decade from 9624 to 116,437; in Oregon from 2243 to 14,811; and in Washington from 2562 to 30,951. The fact that steam power still far exceeds electric power in importance in the manufacturing industries of Oregon and Washington is largely due to the predominance of the lumber industry in these two States, in which industry steam can be generated cheaply by the use of mill waste, sawdust, and so forth.

Development of Hydroelectric Power.

In connection with these statistics of manufacturing establishments on the Pacific Coast and of the power used in them, it may be of interest to call attention likewise to the statistics of the electrical industry as such. Unfortunately the latest census statistics, which relate to the year 1907, are somewhat out of date in an industry of such rapid development.

The census statistics of the production of electric light and power relate only to central stations, which furnish light or power to the outside public. They do not include electric plants operated by manufacturing, mining, or other concerns for the production of current for their own exclusive use. The following statement shows, for each of the Pacific Coast States, the horsepower of primary motors in central electric stations.

Horsepower of Central Electric Stations.

	Total horsepower		Water wheels, 1907	
	1907	1902	Horsepower	Per cent of total
California	384,673	134,788	208,444	54.2
Oregon	126,815	17,798	102,052	80.5
Washington	67,224	22,894	56,118	83.5
Pacific Coast	578,712	175,480	366,614	63.4
Entire United States	4,098,188	1,845,048	1,349,087	32.9
Pacific Coast's percentage of total for United States	14.1	9.5	27.2	

Horsepower of Engines or Motors in Manufacturing Establishments, 1899 and 1909.

	Pacific Coast			California		Oregon		Washington	
	1909	1899	Per cent increase	1909	1899	1909	1899	1909	1899
Total Power	802,016	274,559	192.1	329,100	126,953	175,019	60,005	297,897	87,601
Owned prime motors									
Steam engines	563,000	220,925	154.8	193,526	105,190	112,244	37,986	257,230	77,749
Water wheels	62,273	30,796	102.2	7,390	1,680	47,041	19,263	7,842	6,853
Gas and all other engines	12,986	5,309	144.6	10,425	1,853	825	195	1,736	261
Electric motors run by rented current	162,299	14,129	1,024.8	116,537	9,624	14,811	2,243	30,951	2,562
Other rented power	1,458	3,100	—52.9	1,222	2,606	98	318	138	176
Electric power generated by primary power above	45,802	7,160	539.7	7,147	6,138	5,991	447	12,664	575

This table shows that in 1907 the central electric stations of the three Pacific Coast States together possessed no less than 578,712 horsepower, or 14.1 per cent of the total for the entire United States. The horsepower of stations on the Pacific Coast had more than trebled during the short period between 1902 and 1907. The most striking feature in the Pacific Coast States, however, is the large proportion of electric current which is generated by water wheels. The horsepower of water wheels of central electric stations in these States in 1907 represented more than five-eighths of the total primary horsepower of such stations. This proportion is far higher than in most other parts of the United States. Of the total capacity of water wheels connected with central electric stations in the entire country more than one-fourth is found on the Pacific Coast.

Income of Central Electric Stations From Electric Service.

	Total	Lighting	Stationary Motors	All other
Pacific Coast—				
Amount—1907....	$18,982,000	$11,470,000	$4,733,000	$2,779,000
Amount—1902....	6,324,000	4,389,000	1,385,000	550,000
Per cent from each source, 1907..	100.0	60.4	24.9	14.7
Per cent from each source, 1902..	100.0	69.4	21.9	8.7
United States—				
Amount—1907....	169,615,000	125,755,000	28,512,000	15,348,000
Amount—1902....	84,186,000	70,138,000	9,910,000	4,138,000
Per cent from each source, 1907..	100.0	74.1	16.8	9.1
Per cent from each source, 1902..	100.0	83.3	11.8	4.9

Another noteworthy feature of the statistics of central electric stations on the Pacific Coast is the large proportion of their current which is sold for use in stationary motors, such current for the most part representing that used in manufacturing industries. The statistics do not show the actual quantity of current sold for different purposes, but they do show the amount of revenue obtained from current according to classes of service.

The figures given in the above table for the income from lighting service represent, not only the direct income of the stations from lights operated by ing companies; as the returns of all lighting companies are also included, this item involves some duplication; the other two items have little or no such duplication. The item of "Receipts from all other current" represents chiefly that furnished to street railway companies by the central electric stations. It will be seen that in 1907 the total income of the central electric stations in the Pacific Coast States from electric service was $18,982,000, of which almost exactly one-fourth was derived from current furnished for stationary motors. For the United States as a whole the revenue from current furnished to stationary motors was only about one-sixth of the total revenue. The income of central electric stations on the Pacific Coast from electric service trebled from 1902 to 1907, and the income from current furnished to stationary motors considerably more than trebled.

It is peculiarly fortunate for the manufacturing and other industries of the Pacific Coast that two enormously important new sources of power—oil fuel and water power—have been developed side by side during recent years. Had either one alone come into the field, there might have been some danger of monopoly with consequent high rates for power.

PACIFIC COAST A. I. E. E. CONVENTION.

The 271st meeting of the American Institute of Electrical Engineers was called to order at 11:00 a. m. April 16th, at Portland, Oregon, by F. D. Weber, chairman of the Portland section. S. G. McMeen gave the address of welcome which was responded to by President Gano Dunn.

An excellent program of papers was presented, as has been previously noted in these columns, and a most spirited and enthusiastic discussion was held among the 150 members in attendance. All present voted this to have been the most successful of the Institute meetings yet held in the Pacific Coast, not only in point of attendance and in value of papers presented, but also in the good feeling engendered.

The informal banquet on Tuesday evening was the real get-together of the convention, about 150 members and ladies being seated in the blue dining room of the Hotel Multnomah. F. D. Weber, chairman of the Portland Section introduced B. S. Josselyn, president of the Portland Railway, Light & Power Company, as the first speaker, Mr. Josselyn giving a forceful address of welcome. S. G. McMeen spoke in his inimitable vein of spontaneous wit. W. W. Briggs was then called upon as the only original single-jointed ambidexterous talker on earth. Mr. Briggs maintained his reputation to such good advantage that President Dunn later proposed a fourth grade of membership in the Institute, of which Mr. Briggs would be the first member, a grade still higher than Fellow, namely, that of "Good-Fellow." A. H. Babcock created much amusement by explaining the "kitchen cabinet," but later took the membership to task for neglecting the proper spirit of welcome to President Dunn in their eagerness to tell about local things for which Mr. Dunn had frequently expressed the greatest admiration and appreciation. President Dunn's opening remarks and pleasing manner earned for him the title of the "golden tongued speaker." As he proceeded he gracefully took up the subject appointed, that of the next International Engineering Congress to be held in San Francisco in 1915, paying a glowing tribute to those San Francisco members who had succeeded in obtaining this. J. E. MacDonald with a few clever anecdotes handled the subject of "Conventions" most satisfactorily. J. E. Davidson, manager of the Pacific Power & Light Company, told of the coming National Electric Light Association Convention at Seattle. The last scheduled speech was by Mr. Ralph W. Pope, honorary secretary. In addition there were a number of unannounced speeches by Mr. Dunn and Mr. McMeen much to the delight of the listeners and Mrs. A. H. Babcock responded to the president's request to give them a few remarks, in her usual capable and witty manner. The president then proposed three cheers for the first lady to speak at an A. I. E. E. gathering.

Wednesday morning was devoted to papers and discussions and in the afternoon over one hundred members and their ladies embarked on the steamer "Undine" for a trip to Willamette Falls. A stop was made at Station "A" of the Portland Railway, Light & Power Company in order that the visitors might inspect its equipment, the feature of saw-dust fuel

exciting most comment. The trip to the falls was uneventful but on the return the vessel ran aground while attempting to navigate an abrupt turn in the swift current and after futile attempts to float her a call was sent to Portland for another boat. Meanwhile, the ladies and their escorts were taken off in a launch and were returned from Oregon City on the interurban electric while the remainder awaited until a later hour for the boat from Portland.

The whole of Thursday was devoted to papers and discussions and in the evening Mr. A. B. Babcock brought the regular sessions of the convention to a close with an illustrated lecture on the Southern Pacific Company's electric suburban system around San Francisco Bay. This was given in the ball-room of the Hotel Multnomah with a large attendance.

At the conclusion of the lecture, O. B. Coldwell, in behalf of the Portland Section, presented President Dunn with a massive silver loving cup. Mr. Dunn was completely taken by surprise and was momentarily at a loss for words notwithstanding his quick wit and everready gift for speaking. However, in a few words of pleasing tribute he expressed his thanks and in closing invited the assembly to join him in christening the cup. Brimming with champagne it was passed around several times, thus giving a most happy and auspicious ending to the convention.

On Friday an all-day excursion was taken to the River Mill and Estacada plants of the Portland Railway, Light & Power Company in a special train occupied by 150 members and guests. Lunch was served at the hotel and the day made pleasant by every possible courtesy from the company officials.

The following guests and members were in attendance:

Visiting Ladies.

Babcock, Mrs. A H.	Oakland, California
Brereton, Mrs. W. P.	Portland, Oregon
Briggs, Mrs. W. W.	San Francisco, California
Bowden, Mrs. R. A.	San Francisco, California
Barthold, Mrs G. M.	Portland, Oregon
Eliot, Mrs. Edward M.	Portland, Oregon
Cramer, Mrs. L. B.	Portland, Oregon
Corbett, Mrs. L. J.	Moscow, Idaho
Collins, Mrs. C R	Seattle, Washington
Coldwell, Mrs. O B.	Portland, Oregon
Deakin, Mrs. G.	Berkeley, California
Ewart, Mrs. Erma	Portland, Oregon
Ewart, Mrs. A C	Portland, Oregon
Ewart, Miss Evalyn	Portland, Oregon
Fuller, Mrs F. I.	Portland, Oregon
Fullerton, Mrs. D. P	San Mateo, California
Hillebrand, Mrs. W. A.	Corvallis, Oregon
Kribs, Mrs G.	Portland, Oregon
Martin, Mrs. J. C	Portland, Oregon
Monges, Mrs R F.	Portland, Oregon
McMeen, Mrs. S. G.	Chicago, Illinois
Moody, Mrs A. S.	Portland, Oregon
Nock, Mrs. G. P	Portland, Oregon
Pruden Miss A. Bird	Portland, Oregon
Pope, Mrs. Ralph W	Elizabeth, New Jersey
Peaslie Mrs Maude M.	Portland, Oregon
Smith, Mrs Clinton B.	Portland, Oregon
Scott, Mrs. William D.	Portland, Oregon
Searing, Mrs. E. D.	Portland, Oregon
Turner, Mrs. Wm. S.	Portland, Oregon
Le Tourneau, Mrs. E H	Portland, Oregon
Van Norden, Mrs R. W.	San Francisco, California
Weber Mrs F. D.	Portland, Oregon
West Mrs. Edward A.	Portland, Oregon
Wakeman, Mrs. Wm. J.	Portland, Oregon

Local Members and Their Guests.

Anderson, B. L.	Geisbeek S.	Rawson, F. P.
Barthold, G. M	Green, Franklin C.	Reed, M. E.
Burghduff, A. E.	Harris, Geo F	Rockwood J. A.
Brill, O. C	Herza, L. F	Roberts, T
Beagles, Fred	Hoen, W M	Read, Lance
Bonness, E W.	Herring, W E.	Ransopher S. M.
Baldwin, L. H	Hays, D. S.	Simpson, C M
Barton, R. C	Kribs, Gordon	Schoolfield, H. H.
Brereton W P.	Komler, G. A.	Smith, C. M
Barker Geo. N.	Lauridsen, L	Scott, W D
Bell, H. W.	LeFever, O. D.	Smith Clinton D.
Brown, C. L.	Lebenbaum, Paul	Stearns Wm. G
Cramer L. B.	Lavyne S. Herbert	Smith, Warren P.
Coldwell, O. B	Miller, E. B.	Searing, E. D
Chace, W. B.	McGonigle, Chas.	Swartz, T. W.

Colvin, C. W.	Monges, R. F.	Shearer, H. A.
Cannon, E. F.	Martin, J. C.	Townsend, J. R.
Condit, B. C.	Murphy, F. H.	Turner, Wm. S.
Condit, E. R.	McGee, D. F.	Le Tourneau, E. H.
Carroll, R. S.	Moody, A. S.	Vorse, H. L.
Campbell, W. C.	McMicken, A. C.	Weill, Stuart I.
Darlington, F. W.	McCoy, Louis E.	Whipple, Cyrus A.
Davis, J. R.	Montieth, Arthur D.	Wernicke, Carl L.
Elder, L. R.	Mulock, Red H.	Wakeman, H. R.
Eliot, Edward M.	Nock, G. P.	Weber, F. D.
Friendly, H. M.	Osborn, C. P.	Whitney, E. F.
Fuller, F. I.	Parker, G. L.	Waldman, C. A.
Gray, J. S.	Peaslee, W. D.	West, Edward A.
Grey, G. O.	Porz, H. E.	

Visiting Members and Their Guests.

Asplund, J. W.	Marshfield, Oregon
Alvord, R. M	San Francisco, California
Albert, L. F.	Moscow, Idaho
Allen, E. G.	Seattle, Washington
Blaisdell, Jerome	Bull Run, Oregon
Balknap, J. H.	Corvallis, Oregon
Brofos, E. A.	New York City
Briggs, W. W.	San Francisco, California
Boesch, John Emile	Vancouver, British Columbia
Bass, J. E.	Los Angeles, California
Boynton, W. P.	Eugene, Oregon
Babcock, A. H.	San Francisco, California
Converse, Professor Charles Willard	Eugene, Oregon
Coaterline, Harold	Eugene, Oregon
Corbett, L. J.	Moscow, Idaho
Clark, S. B.	Oswego, Oregon
Currin, H. P.	Cottage Grove, Oregon
Carpenter, H. V.	Pullman, Washington
Cohen, Leeser R. Solis	Corvallis, Oregon
Cooley, Geo. R.	Seattle, Washington
Cornick, Tully R.	Petaluma, California
Collins, C. R.	Seattle, Washington
Christiansen, Conrad	Toledo, Oregon
Creveling, A. B	Pullman, Washington
Chappell, W. Campbell	Vancouver, British Columbia
Dearborn, R. H.	Eugene, Oregon
Day, R. C.	Corvallis, Oregon
Dyson, A. H.	Chicago, Illinois
Dunn, Gano	New York City
Deakin, G.	San Francisco, California
Downing, P. M.	San Francisco, California
Dunphy, Chester A.	Pullman, Washington
Ewart, Fred E.	Corvallis, Oregon
Eisenmenger, F. Z.	Cleveland, Ohio
Edgar, B C.	San Francisco, California
Euler, W. G. B.	San Francisco, California
Fisken, John B.	Spokane, Washington
Fujihira, Y.	Wakayama, Japan
Fullerton, D.	San Mateo, California
Gilbert, L. D.	Los Angeles, California
Greisser, V. W.	Spokane, Washington
Griswold, A. H.	San Francisco, California
Gaytes, Herbert	Oakland, California
Goodwin, W. L.	San Francisco, California
Goldrick, H. C.	San Francisco, California
Hungate, J. W.	Spokane, Washington
Hall, H. Y.	San Francisco, California
Haller, L. W.	Corvallis, Oregon
Hillebrand, W. A.	Corvallis, Oregon
Howes, Robert	Seattle, Washington
Jepperson, A M.	Corvallis, Oregon
Jeter, F. A.	Spokane, Washington
Ismey, James	Pullman, Washington
Jones, Allen G.	San Francisco, California
King, John R.	Seattle, Washington
Kennedy, Rolland C.	Eugene, Oregon
Keehhar, Bishan Dass	Nurmahal, India
Kistler, L H.	Eugene, Oregon
Lake, Norman L.	Pullman, Washington
Lisberger, S. J.	San Francisco, California
Lindsay, S. C.	Seattle, Washington
Miller, A A.	Seattle, Washington
Meyers, Cyrel H	Gresham, Oregon
Macdonald, J. E.	Los Angeles, California
Martin, Alex	Eugene, Oregon
Murphy, E. M.	Burke, Idaho
McGuire, J. P.	Eugene, Oregon
Main, Wm. S.	Eugene, Oregon
Murphy, George R	San Francisco, California
Milner, Geo. R.	Corvallis, Oregon
McMillan, Fred O.	Corvallis, Oregon
Nims, F. D.	Vancouver, British Columbia
Neill, Will T.	Eugene, Oregon
Northrop, F. Ford	Eugene, Oregon
Nelson, I. E.	Corvallis, Oregon
McKenzie, Robert R.	Corvallis, Oregon
LaMoulin, Walter W.	Corvallis, Oregon
McMeen, S. G.	Chicago, Illinois
Outhank, Karl W.	Eugene, Oregon
Pope, Ralph W.	Elizabeth, New Jersey
Pattee, Clyde	Eugene, Oregon
Porter, C. J.	Port Dover, Ontario, Canada
Shepard, E. R.	Corvallis, Oregon
Saurman, A. B.	San Francisco, California
Smith, Byron H.	Springfield, Oregon
Sampson, Geo. H.	Calgary, Alberta, Canada
Schoel, W. A.	Dallas, Oregon
Spurrier, Odith K.	Corvallis, Oregon
Smith, Hugh I.	Corvallis, Oregon
Stewart, S. I.	Lebanon, Oregon
Thayer, Geo.	Eugene, Oregon
Turner, C. A	San Francisco, California
Varner, W. R.	Corvallis, Oregon
Van Norden, Rudolph W.	San Francisco, California
Woods, J. LeRoy	Albany, Oregon
Wooster, L. F.	Corvallis, Oregon
Wright, L. Earl	Pullman, Washington
Washburne, Claude B.	Springfield, Oregon
Weniger, W.	Corvallis, Oregon
Welch, James W.	Pittsburg, Pennsylvania
Yates, J. E.	Pullman, Washington
Zipp, Philip H.	Oswego, Oregon

WESTERN LAWS OF ELECTRICITY AND WATER

THE DOCTRINE OF APPROPRIATION.

BY A. E. CHANDLER.

Most of the Western States have adopted statutes which place the control of water appropriations in the office of the State Engineer. In all but a few, such statutes were but recently adopted so that the great mass of water rights resting on the doctrine of appropriation must be defined by the principles laid down from time to time by the courts. In the first article it was stated that the California statutes (Sections 1410 to 1422 of the Civil Code) were but declaratory of existing law (established by the courts). Similar statutes were first adopted in the other Western States and the court rulings throughout differ but little.

Appropriations Not Restricted to Public Lands.

The statement is generally made by those advocating the riparian doctrine that appropriations (in riparian right States) can only be made on the public lands and this view is somewhat sanctioned by earlier California decisions. In Duckworth v. Watsonville (150 Cal. 520) the rule is positively stated as follows:

The right to appropriate water under the provisions of the Civil Code is not confined to streams running over public lands of the United States. It exists wherever the appropriator can find water of a stream which has not been appropriated and in which no other person has or claims superior rights and interests.

The above does not mean that one may trespass upon private property and make a diversion. The right of way for the ditch or conduit must, of course, be secured from the owner of the riparian land.

In regard to appropriations and use on public lands not subject to entry it has been recently held by the Supreme Court of Washington in Avery v. Johnson (109 Pac. 1028) that no such right "can be acquired by one illegally occupying land in an Indian reservation, prior to the opening of the reservation to settlement under the homestead law."

Waters Open to Appropriation.

The statutes governing appropriations refer to the waters subject thereto as "running water flowing in a river or stream," "natural watercourses," "all waters," or use other expressions of the same nature, and a few enumerate in addition "lakes" and "springs." The courts treat the waters of a "natural watercourse" as being open to appropriation and a definition often quoted is the following, from Los Angeles, etc. v. Los Angeles (103 Cal. 466).

There must be a stream, usually flowing in a particular direction, though it need not flow continually. It may sometimes be dry. It must flow in a definite channel, having a bed or banks, and usually discharge itself into some other stream or body of water. It must be something more than a mere surface drainage over the entire face of the tract of land, occasioned by unusual freshets or other extraordinary causes. It does not include the water flowing in the hollows or ravines in land, which is mere surface water from rain or melting snow (i.e., snow lying and melting on the land), and is discharged through them from a higher to a lower level, but which at other times are destitute of water. Such hollows or ravines are not, in legal contemplation, watercourses.

The statement that all waters of natural watercourses may be appropriated must be qualified in the case of navigable streams. In Miller v. Enterprise Company (142 Cal. 178) the plaintiff sought to enjoin the defendant, a subsequent appropriator, from interfering with his dam and ditch, and the latter defended its action on the ground that plaintiff's dam obstructed a navigable stream, the San Joaquin River. It was held that as the plaintiff had for many years appropriated water from the river, a navigable stream, without complaint from any public authority, state or national, and that while navigation had been interfered with, no person not connected with the government could complain. All cases between individuals raising the question of interference with navigation will undoubtedly be decided in the same way. It is well established, however, that the government may not only stop diversions from the navigable part of a stream but also even those from the non navigable part, including tributaries, if such diversions will interfere with navigation. (United States v. Rio Grand D. & I. Co., 174 U. S. 690).

In actual work lake waters are often appropriated. It was contended in the Duckworth case (above) that such waters were not "running water flowing in a stream," but the court held:

We think the better doctrine in respect to the character of a stream from which the statute provides for appropriations is that it is not necessary that the stream should continue to flow to the sea or to a junction with some other stream. It is sufficient if there is flowing stream; and the fact that it ends either in a swamp, in a sandy wash in which water disappears, or in a lake in which it is accumulated upon the surface of the ground, will not defeat the right to make the statutory appropriation therefrom, and we can see no reason why the appropriation in such a case may not be made from the lake in which the stream terminates, and which therefore constitutes a part of it, as well as from any other part of the water course.

In Hough v. Porter (98 Pac. 1083) the Oregon Supreme Court held, contrary to the above, in speaking of riparian rights, that when water spreads, as in a swamp or marsh, "with no well-defined current it cannot be deemed a water course." As the Oregon statutes now provide for the appropriation of "all waters" within the State, this ruling cannot affect appropriators.

It is well settled that water in artificial channels or reservoirs cannot be appropriated and waters artificially developed as in a mining tunnel and allowed to flow in a natural water course to place of intended use are likewise exempt. It has been recently held by the Supreme Court of New Mexico in Vanderwork v. Hewes (110 Pac. 567), decided August 9, 1910, that "seepage water or waters from snows, rain, or springs, not traceable to and forming a stream or water course" may be used by the owner of the land on which they rise and are not subject to appropriation without his consent. The rule was followed by the Idaho Supreme

Court in King v. Chamberlin (118 Pac. 1099) decided Nov. 3, 1911, where the waters in question were surface waters collected in a reservoir on plaintiff's land.

In the first article the notice of appropriation from De Wolfskill v. Smith (5 Cal. App. 175) was given. It was for the water flowing from abandoned oil wells on the public domain. The court held that as the water had gathered into a stream, it was immaterial "whether this stream is supplied by water percolating and filtering through the earth or not." The difference between this case and those cited in the last paragraph is that these waters, though artificially developed, had been abandoned, and the others had been retained in private possession.

Proceedings to Effect Appropriations.

An appropriation has been defined as "the intent to take, accompanied by some open, physical demonstration of the intent, and for some valuable use."

Since the adoption of the early statutes providing for the posting of notices at the point of intended diversion, the "intent" is expressed in the notice. Following the notice, the steps are the recording of the notice and the initiation of the construction work within the time designated—generally ten and sixty days respectively—the prosecution of construction to completion with reasonable diligence and the application to beneficial use. If the steps be followed, the water right dates from the posting of the notice.

The question of reasonable diligence is a serious one and especially so as a very erroneous view is abroad in the land. A common idea is that all one need do "to hold the claim" is to act about as he would to hold a mining claim, and the result is that the occasional use of a shovel and wheelbarrow are supposed to satisfy the requirement. The error of this view was shown in a very early Nevada case, Ophir Mining Company v. Carpenter (4 Nev. 534) which is often quoted on this question by other courts. The following sentences are very much to the point and picture conditions typical of far too many of our so-called water claims:

> If the labor of twenty men for three or four months, in a period of two years and a half, constitutes diligence in the prosecution of such a vast enterprise as this, it is difficult, if not impossible, to designate the entire want of diligence. The manner in which this work was prosecuted certainly does not accord with what is generally understood to be reasonable diligence. Diligence is defined to be the "steady application to business of any kind, constant effort to accomplish any undertaking." The law does not require any unusual or extraordinary efforts, but only that which is usual, ordinary and reasonable. The diligence required in cases of this kind is that constancy or steadiness of purpose or labor which is usual with men engaged in like enterprises, and who desire a speedy accomplishment of their designs. Such assiduity in the prosecution of the enterprise as will manifest to the world a bona fide intention to complete it within a reasonable time. It is doing of an act, or series of acts, with all practical expedition, with no delay, except such as may be incident to the work itself. * * * * * The weather would not have prevented work upon this ditch ordinarily more than three or four months in the year, hence labor upon it could probably have been prosecuted during eight or nine months out of every twelve. Here, however, there was a period of thirty months, when only about three months' work was done, or one month out of every ten. Rose during this time may have dreamed of his canal completed, seen it with his mind's eye yielding him a great revenue; he may have indulged the hope of providential interposition in his favor; but this cannot be called a diligent prosecution of his enterprise. Surely he could hardly have expected to complete it during his natural life by such efforts as were made through this period.

As the question of diligence is one of fact it will ordinarily, in case of litigation, be decided by a local jury. The jury may have a far less stringent view of "that constancy or steadiness of purpose or labor" than the ordinary engineer, but it will be obliged to decide on at least a fair degree of it. The size and character of the works, the natural conditions, including climate and material, and all other modifying elements, must be considered. Illness or lack of money are generally held to be no excuse for delay but the latter has been accepted as a valid excuse in Colorado and Idaho.

Incomplete Appropriations.

Prior to the completion of the diversion works and the readiness to apply the water to beneficial use the appropriation is incomplete. In Rincon Water & Power Company v. Anaheim Union Water Company (115 Fed. 543) Judge Welborn after quoting Sections 1415 to 1418 of the California Civil Code said:

> It is obvious that a person who intends to become an appropriator under these sections cannot acquire the exclusive right to the use of the water he intends appropriating, nor maintain any suit, either at law or in equity, for its diversion, until all the steps requisite to an appropriation have been taken. * * * From the statutory enactments and general principles above quoted and stated, the conclusion is not only fair, but unavoidable, that the only right which a person acquires by posting a notice is the right to prosecute without interference the works necessary to consummate his intended appropriation.

The question was before the California Supreme Court recently in two cases, resulting from the operations of Los Angeles in the Owens Valley—Inyo Consolidated Water Company v. Jess (119 Pac. 934) decided Dec. 11, 1911, and Merritt v. Los Angeles (120 Pac. 1064) decided Jan. 19, 1912. The plaintiff in each case had filed a notice of appropriation on a stream within a national forest and had made application to the Forest Service for permission to construct the conduit. No work had been done in either case as the Forest Service had not acted on the application, and Section 1422 of the Civil Code allows 60 days after the grant of permission from the federal authorities in which to begin construction. Each action was brought to obtain an adjudication of the alleged conflicting claims and the lower court, following the early decisions, decided that the plaintiff had no property interest on which to base the suit. The Supreme Court, however, decided that the plaintiff had "an incomplete, incipient, conditional right in the water, which is a vested interest in real property, and which may be adjudged to be such in an action to determine conflicting claims." In the later case the Supreme Court added:

> Such judgment, of course should not declare the plaintiff absolutely entitled to the water, nor enjoin the defendant from taking or using it during the intervening time prior to the completion of plaintiff's works to a stage which will enable him to divert and use it. It should only declare and describe the plaintiff's contingent right to use the water and enjoin adverse claims or uses injurious thereto.

The only effect of the two decisions, therefore, is to secure to the owner of an incomplete right a determination of conflicting claims. They do not allow interference with either construction of works or actual diversions.

The Measure of the Right.

Under a great many of the early decisions not only was the minimum capacity of the ditch decreed but very often the amount mentioned in the notice, which might be far in excess of the maximum capacity. The holders of these old rights very naturally looked upon the amount decreed as their water, whether they had use for it or not, and believed that they had the right to sell as desired. No court would tolerate such a view today. It is now generally held that a right to the use of water is limited in time and volume to the extent of the needs of the possessor thereof.

The rule is well illustrated by the following quotation from McCoy v. Huntley (119 Pac. 481) decided by the Supreme Court of Oregon Jan. 15, 1912.

We see no reason why, even in cases involving prior and subsequent appropriations of water, the courts cannot require the appropriators to alternate in the use of the water. The time when water may be used recklessly or carelessly has passed in this State. With increasing settlement water has become too scarce and too precious to justify any but an economical use of it. An appropriator has only the right to use so much as his needs require and at the time his needs require. And if these are satisfied by a use of the whole flow every other day, or every alternate week, he ought not to be heard to complain. It is evident that from some cause or from a variety of causes the waters of Pine creek are diminishing in volume at the point where the parties to this controversy are residing. It is now probable that to divide the water, without alternating, would injure both parties. A test, since the preliminary order was made in this case in 1906, indicates that by the method adopted both parties can raise good crops and both prosper.

Principles of Prior Appropriation.

Probably the best judicial summary of the principles of prior appropriation appearing in the reported cases is that of Judge Hawley in Union Mill & Mining Company v. Danburg (81 Fed. 73) decided May 24, 1897. It was Judge Hawley who, when a justice of the Nevada Supreme Court, wrote the opinion in Jones v. Adams overruling Van Sickle v. Haines and abrogating the doctrine of riparian rights in Nevada. His opinions in both the law of mines and the law of waters show a deep knowledge of the industries affected and an earnest desire to assist in bettering conditions. The reader will find the Dangberg case both interesting and instructive. The summary follows:

Under the principles of prior appropriation, the law is well settled that the right to water flowing in the public streams may be acquired by an actual appropriation of the water for a beneficial use; that, if it is used for irrigation, the appropriator is only entitled to the amount of water that is necessary to irrigate his land, by making a reasonable use of the water; that the object had in view at the time of the appropriation and diversion of the water is to be considered in connection with the extent and right of appropriation; that, if the capacity of the flume, ditch, canal, or other aqueduct, by means of which the water is conducted, is of greater capacity than is necessary to irrigate the lands of the appropriator, he will be restricted to the quantity of water needed for the purposes of irrigation, for watering his stock, and for domestic use; that the same rule applies to an appropriation made for any other beneficial use or purpose; that no person can, by virtue of his appropriation, acquire a right to any more water than is necessary for the purpose of his appropriation; that, if the water is used for the purpose of irrigating lands owned by the appropriator, the right is not confined to the amount of water used at the time the appropriation is made; that the appropriator is entitled, not only to his needs and necessities, at that time, but to such other and further amount of water, within the capacity of his ditch, and further amount of water, within the capacity of his ditch, as would be required for the future improvement and extended cultivation of his lands, if the right is otherwise kept up; that the intention of the appropriator, his object and purpose in making the appropriation, his acts and conduct in regard thereto, the quantity and character of land owned by him, his necessities, ability, and surroundings, must be considered by the courts, in connection with the extent of his actual appropriation and use, in determining and defining his rights; that the mere act of commencing the construction of a ditch with the avowed intention of appropriating a given quantity of water from a stream gives no right to the water unless this purpose and intention are carried out by the reasonable, diligent, and effectual prosecution of the work to the final completion of the ditch, and diversion of the water to some beneficial use; that the rights acquired by the appropriator must be exercised with reference to the general condition of the country and the necessities of the community, and measured in its extent by the actual needs of the particular purpose for which the appropriation is made, and not for the purpose of obtaining a monopoly of the water, so as to prevent its use for a beneficial purpose by other persons; that the diversion of the water ripens into a valid appropriation only where it is utilized by the appropriator for a beneficial use; that the surplus or waste water of a stream may be appropriated, subject to the rights of prior appropriators, and such an appropriator is entitled to use all such waters; that, in controversies between prior and subsequent appropriators of water, the question generally is whether the use and enjoyment of the water for the purposes to which the water is applied by the prior appropriator have been in any manner impaired by the acts of the subsequent appropriator." Union Mill & Mining Company v. Dangberg, 81 Fed. 73.

SHOULD COMPANIES BE TAXED FOR POWER SOLD TO SUBSIDIARIES?

Attorney-General Webb of California has been called upon by the State Board of Equalization to advise the board on an important question concerning the proper procedure to be followed by the board in the matter of taxing or exempting from taxation the power generated by companies which sell part of their output to subsidiary concerns and use the remainder for their own purposes. The board holds that where a corporation generates power, such as electricity, for the manufacture of ice, using the ice to refrigerate cars, that power is a just charge on the company in its report of gross earnings.

Some of the corporations deal in power in this way, selling it to its subsidiary concerns, using some of it for itself and selling the product. It claims exemption from charge for the power as an item of its earnings.

This question was raised last year by several large operative concerns and a satisfactory adjustment could not be reached by the board and the contending concerns. The Attorney-General has been called upon to solve the knotty problem, and upon his decision rests whether or not the companies will be charged up with the important item.

The board claims that by allowing exemption from State taxation on this one point will result in many evasions by the big concerns.

DRAFTING ROOM PRACTICE, II.

BY A. L. MENZIN.

The making of drawings involves two classes of work—pictorial representation and lettering. The first is produced by the use of lines of various structure and of various thicknesses. To secure uniformity, certain lines must be adopted as standard for certain purposes: the selection of these lines is dictated by the requirements of rapid execution and artistic appearance.

Solid lines can be drawn much more rapidly than lines made up of dashes, and lines made up of long dashes can be drawn much more rapidly than lines made up of short ones; for the time required to draw a line between two given limits is practically proportional to the number of pauses made. Solid lines should therefore be used as freely as is consistent with clearness and artistic appearance, and when broken lines are desirable the dashes should be as long as will look well.

Light lines permit of much more rapid work than heavy lines; for the heavier the lines, the longer it will take for the ink to dry and the slower will be the progress possible. A too liberal use of heavy lines is therefore undesirable.

In the choice of lines due consideration must be given to the appearance of the ultimate result. The tracing is not in itself the ultimate result but is only a means to an end—the blue print. A well appearing tracing does not necessarily assure a well appearing blue print, for blue printing produces some very noticeable differences in contrasts.

If a blue print is examined it will be noticed that the fine lines have a bluish tinge while the heavy lines are white. There is therefore much greater contrast between the heavy and light lines on a blue print than between similar lines on the tracing. There is also much less contrast between bluish white lines and the blue surface of the blue print paper than between black lines and the bluish white surface of the tracing cloth.

On account of the tracing being a positive and not a negative, lines on a blue print are somewhat thinner than corresponding lines on the tracing. This should also be kept in mind.

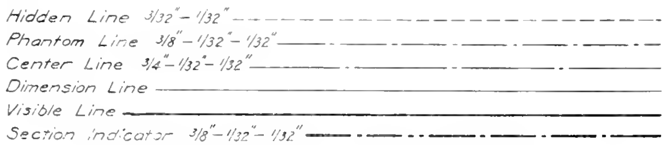


Fig. 1. Standard Lines for Working Drawings

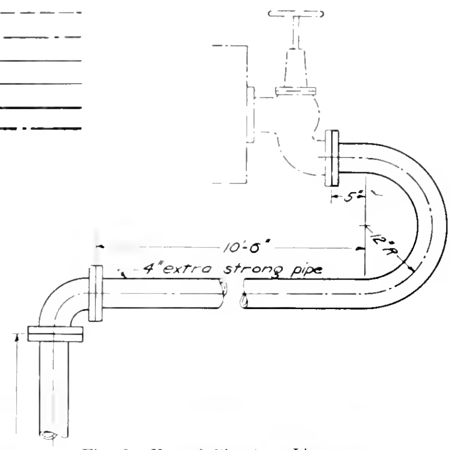


Fig. 3. Use of Phantom Lines.

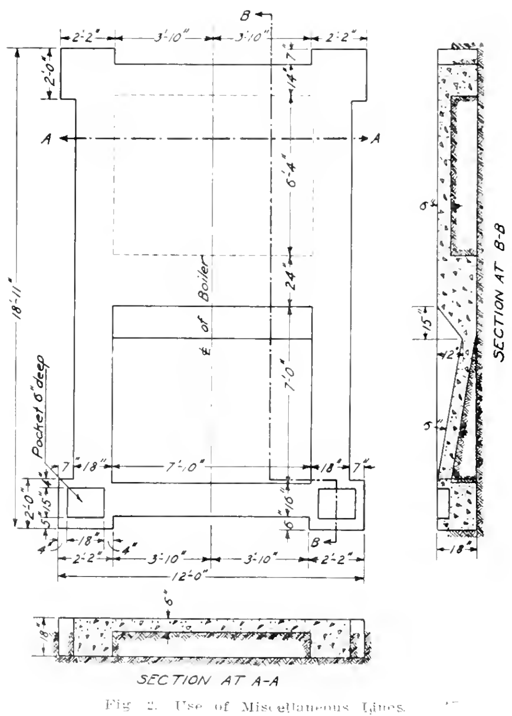


Fig. 2. Use of Miscellaneous Lines.

Fig. 4. Method of Drawing Heavy Lines.

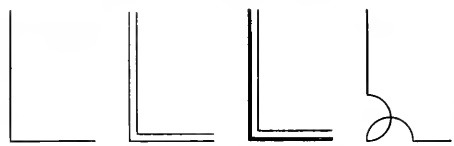


Fig. 5. Miscellaneous Margins.

Allowance should be made for a reasonable amount of underprinting and overprinting, for blue prints are made rapidly and without especial care. The tracing must be such as to assure a good average print.

For the requirements of the commercial drafting room the lines shown in Fig. 1 are suggested.

The hidden line is the lightest, the center, phantom and dimension lines are somewhat heavier, the visible line is decidedly heavier and the section indicator is heavier still.

Hidden lines should be preferably as light as can be drawn with the pen for then the visible lines will stand out more prominently and make the appearance of the object clearer.

To the left of the lines in Fig. 1 are given lengths of dashes and spaces. These are, of course, approximated by eye. By having some definite dimension in mind more uniform work will result.

Fig. 2 shows a boiler foundation and is intended to illustrate the use of all the lines noted above except the phantom line.

The limit lines for dimensions should approach but not touch the visible lines, so as not to confuse the appearance of the object. It is also advisable to keep the dimension lines off of the object as much as

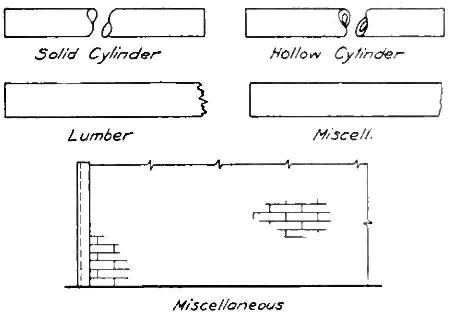


Fig. 6. Conventional Breaks.

possible for the same reason, but this should not be carried too far.

A good rule for placing dimension lines is to put them on the view on which the constructor will measure them. An observance of this rule will often save the constructor a great deal of labor in mentally transferring dimensions from one view to another.

The section indicator, as its name implies, is used to indicate that a sectional view along its length may be found elsewhere. The placing of arrows on the indicators, as at A—A and B—B, gives them more prominence, which is desirable.

Fig. 3 is supposed to be part of a piping drawing and is intended to show the use of the phantom line. It is often desired to include in a drawing the relative position of an object which the drawing does not call for, such as the throttle valve in the drawing referred to. The phantom line is also used to represent an alternative position of an object shown on the drawing in visible lines, such as a gate, lever, valve, etc. Lines consisting of dashes are often used for this purpose. The combination of long and short dashes seems to look better. This, of course, is a matter of personal taste.

Besides the lines noted above it is often desirable to draw heavier lines for margins, section lining, shading, etc. If a heavy line is drawn at one stroke considerable ink will be deposited and, if the line is long, the amount of ink in the pen will often not be sufficient to complete the line. To avoid these objectionable possibilities the line may be built up of a number of finer lines drawn so they just lap, which may be easily done by moving the straight edge the desired amount each time. Fig. 4 is a full size reproduction of heavy lines built up with four strokes.

Fig 5 shows some margins which are suitable for working and illustrative drawings.

Fig. 6 shows the conventional breaks most often used. For long breaks the toothed line in the lowest illustration looks much neater than an irregular line. The teeth may be made with a 60 degree triangle, or freehand, as desired.

ENGINE GAS FROM PEAT.

The production of gas from peat having a low water content (up to about 20 per cent) for use in suction gas engines has already met with considerable success in Germany, but for a number of years efforts have been made to utilize peat with a water content as high as 50 to 60 per cent and thus eliminate the costly process of drying the raw material.

Difficulties have been encountered in preventing a loss of heat through radiation and other causes, and in getting rid of the dust and tar vapors carried over by the gases to the engine; but great strides have been made recently in overcoming these obstacles. Peat with a water content up to 60 per cent has been found to be a suitable fuel. Owing to its great porosity and low specific gravity it prevents a large combustion surface in the generator, so that the oxygen in the air used as a draft can easily unite with the carbon of the peat.

One of the great difficulties is to eliminate the tar vapors that clog up many of the working parts of the engine. The passing of the gas through the wet coke washers and dry sawdust cleansers does not appear to have thoroughly remedied the evil. Efforts were therefore made to remove the tar-forming particles of the gas in the generator itself or to render them harmless. That of the Aktien-Gesellschaft Gorlitzer Maschinenbau Anstalt und Eissengiesserei of Gorlitz, was displayed at the exposition at Posen in 1911. The gas from the generating plant was employed in a gas-suction engine of 300 horsepower used to drive a dynamo for developing the electric energy for the exposition. The fuel used was peat with a water content of about 40 per cent. The efficiency and economy results obtained were very promising.

The advantages claimed for the Gorlitz engine are that the sulphurous gases and those containing great quantities of tar products are drawn down by the suction of the engine through burning masses of peat and thus rid of their deleterious constituents. The air for combustion purposes is well heated before entering the combustion chamber, thereby producing economical results. It is claimed also that the gas produced by its system is so free from impurties that the cleaning and drying apparatus may be of the simplest kind.

The cost of the peat used (water content, 40 per cent) was $0.57 per metric ton (2,204.6 pounds). In two trials the consumption per kilowatt-hour obtained was 3.43 pounds for the first trial and 5.31 pounds for the second.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

A Demand for Wireless Equipment

The whole world has stood aghast the past ten days in hearing recited the horrors of the Titantic disaster. To those familiar with conditions off the coast of Newfoundland, the wonder is, not that one gigantic ship has met its fate, but that six to eight a year are not taken to a watery grave.

Careful students of the details of this catastrophe see in it many timely warnings. In addition to the horrible demonstration of the necessity for ocean-going vessels being equipped with enough life boats for all passengers, a crying need for better and more independent wireless equipment is also forcefully shown. Within recent years wireless messages and their brave operators have done more to alleviate the sufferings of the sea than any other factor. In the present instance all shudder in horror in contemplating the complete disaster, which would have followed had no wireless communication been possible.

The present agitation to establish at San Francisco the greatest wireless station in the world should receive sweeping commendation. A station should be constructed not only powerful enough to gather the world's progress in business affairs from the burden-laden ships of the Pacific, but its entuning should be so delicate that the low sobs of the trials and dangers of human suffering at sea can be delicately and accurately located.

The proposed site for this great wireless tower, which overlooks the Golden Gate, seems blessed with every physical endowment necessary in the successful installation of a project of this magnitude. May it be the mission of San Francisco, the home of a people who have braved and successfully overcome one of the greatest calamities of history, to have this monument of human usefulness that its citizens may have the privilege of eternally dissipating their sympathy and human charity out over the ocean waves and even to the little isles of the sea, which, though unseen from her shores, are swept by the same powerful and at times cruel forces that beat against the Cliff House at her western boundary.

Electrical Scenting of Icebergs

It is said to be practically impossible to discern the approach of an iceberg in the dead of night, especially one having a sunken tongue extending some distance outward from the main body of ice. To this fact, the ill-fated Titantic bears silent and convincing testimony, though manned by a crew, the pick of England's foremost seamen.

Professor Barnes of McGill University, a careful and scientific student, has accomplished noteworthy results in application of his electrical microthermometer in the vicinity of icebergs. It is found that, since the temperature of ice is lower than the surrounding water, a definite thermal influence is felt for miles out to sea. The law governing the rise in temperature with distance from an iceberg, known as the temperature gradient, has been definitely and positively established by means of the delicate electrical device above mentioned, which accurately regis-

ters temperatures to 0.01 degrees Centigrade. With such a device the approach of an iceberg can be definitely registered seven miles out to sea. A full account of Professor Barnes' experiments are to be found in the issue of Nature of December 1, 1910.

Hitherto, scientific study without applications to human protection has engrossed the energies of those studying the laws of ice bodies. The appalling disaster now so freshly in our minds should indelibly impress upon us the necessity of installing on all ocean-going ships exposed to dangers of icebergs electrical thermal recording devices or some other automatic recorder, which may scientifically scent the approach of possible human disaster from floating bodies of ice.

Pensioning in Public Service Corporations

The wives and sweethearts of many employees of the Portland Railway, Light & Power Company recently received from B. S. Josselyn, president of that corporation, a sparkling ten-dollar gold piece. Upon inquiry as to the "wherefore and the why," it developed that the gift was sent as an appreciative token to all employees who had been with the corporation for five years or over.

The incident naturally brings to consciousness an interesting train of thoughts. The close inquiry into the affairs of public service corporations by the various regulating commissions leads to the suggestion that, along with the sinking funds being set aside for depreciation of material things, it is only just and equitable that funds be also laid aside for depreciation in the human life and activity of those devoting their energies to this phase of public service.

An eminent philosopher once said that there are three factors found in human experience which can positively be counted upon as coming to pass with certainty—death, taxes, and the due date of a note. A fourth may just as truly be mentioned—that of ultimate decreptitude or old age disability after years of faithful service. Ample provision for such a human contingency should certainly be made. The rates charged by the public service corporations are being so thoroughly investigated and such small margins allowed over and above a reasonable return on the capital involved, that a few years hence, when many of these faithful servants have reached the winter time of life, the restricted larder will not be sufficient for the executive officers to deal as generously with the pensioning of employes as they would otherwise.

Like the low death rate and the consequent deceiving nature of a new assessment insurance company, the expenditures of a newly organized public service corporation, in its pension account, is small for many years of its early existence. The unalterable decree of nature, however, must eventually exert itself.

The Pacific Coast executives of the Western Union Telegraph Company have recently received advices of the inauguration of a plan for the benefit of the 30,000 employes connected with that corporation throughout the United States. Those engineers who are connected with out great institutions of learning have been amply provided for in the establishment of the Carnegie Foundation Fund, but the great rank and file in our public service corporations piteously unprovided for, daily trace their outward flow of vital energies on the revolving disk of life. Though this penned line represents real pulsating life, not even the same fond provision is made for it as for the sister dials—the recording wattmeters, the voltmeters and the like, for a carefully guarded depreciation fund awaits with jealous provision the time when age shall slow down their regulated pace.

No sweeter thing can be pictured in human affairs than that of a bright sunny season of well-earned rest in the closing days of the winter of life to reward the faithful. For promotion of such protection, the public service commission should be ready to aid favorable corporation sentiment in every manner possible.

Assurance in Continuity of Service

In the development of the hydroelectric industry, it soon became apparent that unavoidable shut-downs in the mountains would bring loss of prestige, if not an immeasurable loss in patronage, to the enterprise. The tying-in with other hydroelectric properties into one synchronously pulsating network soon established the hydroelectric industry on a much firmer basis. Today the central station, equipped with the steam auxiliary in the busy centers of industry and with two or more hydroelectric stations operating in parallel, has little to fear in the way of interruption in service.

The Stockton plant of the Western States Gas & Electric Company, a description of which is found on another page of this Journal, illustrates advantages to be derived from a mesh-work of possible interconnections. Not only does the double high tension circuit of this installation link the system with its steam auxiliary into an efficient and pliable power supply, but the interconnections with the Pacific Gas & Electric Company, as well as the Sierra & San Francisco Power Company, are a guarantee for continuity of service enjoyed by few plants of its size.

The question of interlinking in one gigantic throbbing network the entire power lines up and down the Pacific Coast at once arises in ruminating upon the Stockton accomplishment. Already the Pacific Gas & Electric Company has at times tied in with the Northern California Power Company's lines, thus making a synchronous electrical impulse felt from Santa Cruz on the south to almost the confines of the great State of California on the north. A temporary barrier is met in connecting with the lines south of Tehachapi Pass or even with the San Joaquin Light & Power Company, for power is generated on 50 cycles by the three great companies to the south. To the northward, in Oregon and even into Washington there seems to be no such "confusion of tongues" to be anticipated and it is not beyond belief that the not far distant future may see these great pulsating systems beating in synchronism from one end of the coast to the other. Such an achievement would make hydroelectric power supply expressible alone in symbolic figures of the heavens, when we say continuity of service would become as "constant as the north-star."

PERSONALS.

H. D. Melone, who has electric lighting interests at Ukiah, was a recent San Francisco visitor.

Frank Brookfield and **Arthur Lockwood** of the Brookfield Glass Company are visiting the Pacific Coast trade.

E. O. Stoddard, vice-president and general manager of Chas. C. Moore & Co., spent last week in Seattle and the Northwest.

Alfred Peterson is at San Francisco, after spending the past year at San Diego in connection with the installation of electrical machinery.

George I. Kinney, manager of the Pacific Coast offices of the Fort Wayne Electric Works, recently returned to San Francisco after visiting the factories.

H. R. Tobey, of N. W. Halsey & Co., of New York, is at San Francisco looking over the electrical properties of the corporations which the firm have financed.

Wynn Meredith, of Sanderson & Porter, is in British Columbia on business connected with the engineering contracts of which his firm has the supervision.

Guy W. Talbot, president of the Pacific Power & Light Company of Portland, left on April 17 for a hurried trip to New York and will be absent about two weeks.

H. C. Goldrick, representing the Kellogg Switchboard & Supply Company on the Pacific Coast, has returned to San Francisco from Puget Sound and British Columbia.

Fred S. Myrtle, head of the publicity department of the Pacific Gas & Electric Company, visited the plants at Nevada City and Colgate, on an inspection tour, during the past week.

S. G. McMeen, president of the Mount Hood Railway, Light & Power Company, which was recently purchased by the Portland Railway, Light & Power Company, is at Chicago.

C. S. Walters of Walla Walla, heretofore general manager of the Walla Walla Valley Railway Company, has been made vice-president and general manager and will continue to reside in Walla Walla.

W. L. Goodwin, vice-president of the Pacific States Electric Company, has returned to San Francisco from Portland, where he found great interest in the coming N. E. L. A. convention at Seattle.

J. H. McGill, of the Crescent Manufacturing Company of Chicago and Valparaiso, Ind., manufacturers of electrical specialties, has been spending several weeks in California and is now at San Francisco.

J. B. Blair has joined the industrial department of the district office of the Westinghouse Electric & Manufacturing Company at San Francisco. He was formerly connected with the Seattle office of the company.

E. G. Williams, chief construction engineer of J. G. White & Co., has been inspecting the construction work on the Oakland & Antioch Railway during the past week. He recently inspected the Midway Gas Company's gas pipe-line work, on which he is using ditching machines.

D. F. McGee, chief engineer of the Pacific Power & Light Company, has been elected vice-president of the Hanford Irrigation & Power Company, an affiliated company, and will have charge of the operation and construction of the Hanford company, in addition to his other duties.

G. W. Canney, who is on the Coast organizing the Westinghouse Electric & Manufacturing Company's new service department, is now at Seattle. The new department amounts to a consolidation of the repair department and the erecting department into one organization. **Thomas Anderson,** who was formerly district erecting engineer, with headquarters at San Francisco, is now known as district superintendent of the service department.

H. T. Cory has returned to San Francisco after spending several weeks in the South in connection with emergency work for the Flood Commission of the State of Georgia. He is preparing complete plans for engineering work to prevent future flood damage from the Savannah River around the City of Augusta.

George R. Throop, of J. G. White & Co.'s staff, is at the head of the field party which went to Fresno during the past week to secure data for a valuation of the San Joaquin Light & Power Corporation's plant and properties. A valuation office has been established by the firm at Fresno for handling the work, which is expected to occupy about three months.

Francis S. Foote, Jr., a graduate of Columbia University's engineering schools, New York, has been appointed associate professor of railway engineering in the department of civil engineering, University of California; his appointment to take effect July 1, 1912. Mr. Foote is at present a member of the instructing staff of the school of railway engineering and administration at the University of Illinois.

A. S. Grenier, for the past two years connected with the Pacific Power & Light Company, Portland, in the capacity of vice-president, left on April 20th for New York, where he will become connected with the American Power & Light Company, which is interested in the Pacific Power & Light Company. Mr. Grenier is leaving for New York to become assistant to Mr. F. G. Sykes, who is now president of the American Power & Light Company and who formerly resided in Portland. As a result of Mr. Grenier's leaving, a number of changes have been announced in the organization of the Pacific Power & Light Company. **J. E. Davidson,** heretofore general manager, has been made vice-president and general manager, and **Lewis A. McArthur,** who has been for two years chief clerk to Guy W. Talbot, has been appointed assistant to the general manager. **George L. Myers** has been elected assistant secretary and assistant treasurer. All of these changes are effective immediately.

PACIFIC COAST TRIP AMERICAN ELECTRIC RAILWAY ASSOCIATON REPRESENTATIVES.

The executive committee of the American Electric Railway Association and representatives of the American Electric Railway Manufacturer's Association have left New York City for an extensive Pacific Coast trip. They will reach Los Angeles soon after the first of May, be at San Francisco May 8-12, Portland May 14-15, and Seattle May 16-17. Elaborate preparations are being made for their entertainment at each of these cities and every facility afforded for a complete investigation of the electric traction situation. The committee will meet the city officials and the various railroad commissions and endeavor to gain a better understanding of the local situation as well as to promote harmony. Those making the trip are T. N. McCarter, of Newark, N. J., president of the American Electric Railway Association and president of the Public Service Corporation of New Jersey. Gen. George H. Harris, of Louisville, Ky., prominently identified with traction and railway interests in the West; C. Loomis Allen, president of the Newport News & Old Point Railway & Electric Company; A. W. Brady, past president of the American Electric Railway Association and president of the Illinois Union Traction Company; James F. Shaw, director of the Boston & Worcester Street Railway Company; W. L. Cornwell, president of the Transportation Utilities Company, of New York; C. C. Pierce, of New York, secretary-treasurer of the American Electric Railway Association; Arthur Warren, representative of the committee of public relations of the American Electric Railway Association.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

Local contractors are figuring on a pole line for the town of Roseville, Placer County, Cal.

W. S. Hanbridge was in Los Angeles Tuesday and Wednesday on State Association business.

R. L. Boynton, of the Central Electric Company, made a flying trip to Los Angeles, Thursday and Friday.

The National Electric Company have signed up a job of wiring for the Land Estate, Mason and Stockton streets.

Plans are out for the electric work on the new Tivoli Theatre, on Eddy street near Mason. An old contractor remarked that this is one of the most perfect wiring plans for a theatre he has ever figured. It is estimated that the job will run $15,000. O'Brien & Werner are the architects.

A movement is on foot to form all of the specialty contractors in San Francisco into a central body for the purpose of protecting and advancing their interests. Frank Klumm, representing the plumbers, Jesse Steer, representing the plasterers, and W. S. Hanbridge representing the electrical contractors, have been appointed as a committee to arrange for the financing and organization. W. S. Scott has been selected as temporary secretary.

The Electrical Contractors' Association are working hard to advance and improve the condition of the electrical business, and they should have the membership and moral support of every electrical contractor in the State. They should have the moral support of every jobber, manufacturer and central station manager in the State. They are going to hold their third annual convention in San Jose during the third week of August. They want to enthuse in the entire electrical fraternity at that time to bring them all closer together, to be able to get their views and assistance in solving the troubles and worries which they encounter in daily life. They want you, Mr. Central Station Manager, to get the electrical contractors in your town around you and get acquainted and show them some of your troubles and work with them and let them work with you, so you can all present a solid front to the public on any electrical problem. They want you, Mr. Manufacturer and Mr. Jobber, to get your salesmen and representatives to feeling that the success of the contractor means your success. Also have your representative say a kind word for the Contractors' Association wherever they can, for remember they are trying to spread the doctrine of doing business right at all times, and it is easier to reach them in a body than separately.

We all know that the most of the contractor's troubles are caused by a lack of business training. Don't lose sight of the fact that while you, gentlemen, were serving your apprenticeship in the business world, the contractors were working just as hard to develop the methods of installing the wiring to supply the apparatus which you handle today. That he has not advanced as far as you, at the business end, is not to his discredit, because he had to start in the lower class after mastering his own craft, and he has surely paid for his education.

That the present generation will bring out many contractors with good business ability we all agree. So let us all join hands in this glorious State of ours and make our slogan "The success of the California State Association of Electrical Contractors." Does not the success of the contractor mean more success to yourself? So, from now on let us lay to our oars and pull hard, "All together, all the time, for everything electrical," and by doing so and pulling together to make the contractors' convention a success, to bring the contractors, jobbers, manufacturers and central stations together for all times; you will have assisted the California State Association of Electrical Contractors in bringing about complete commercial co-operation.

NEW CATALOGUES.

Bulletin No. 4923 from the General Electric Company is an attractive illustrated treatise on Modern Electrical Equipment for Economic Production of Iron and Steel.

Three-wire direct current generators are described together with their principle of operation in a sixteen-page circular (1088) issued by the Westinghouse Electric & Manufacturing Company. Numerous views of applications together with diagrams of connections and views of the component parts are given.

"Train Lighting Lamps" is the title of a bulletin issued March 15th, 1912, by the Engineering Department of the National Electric Lamp Association which is sustained by certain works of the General Electric Company, covering the description, performance and economy of Mazda and Gem lamps in train lighting service.

The Crocker-Wheeler Company has issued an interesting and attractive catalogue on Electric Fans. The first electric fan put on the market was built by the Curtis & Crocker Company in 1886, the invention of S. S. Wheeler, now president of the Crocker-Wheeler Company. Diagrams are given to show the greater air delivery of the latest Crocker-Wheeler fans.

The Chicago Fuse Manufacturing Company have issued their Catalog No. 26 covering complete line of "Union" fuse protecting materials. Particular attention is called to the additions made to their line of National electrical code fittings and high voltage fuses and blocks, also, their attitude on the question of refilled fuses. The tabulation and arrangement is exceedingly convenient for ready reference.

Multiple Unit Trains and HL Control is the title of an interesting circular (1522) issued by the railway and lighting department of the Westinghouse Electric & Manufacturing Company. Folder 4019, issued by the same company, covers type F carbon circuit-breakers. These breakers are intended for the protection of lighting circuits and small direct current motor installations, being used to combine the functions of fuse and switch.

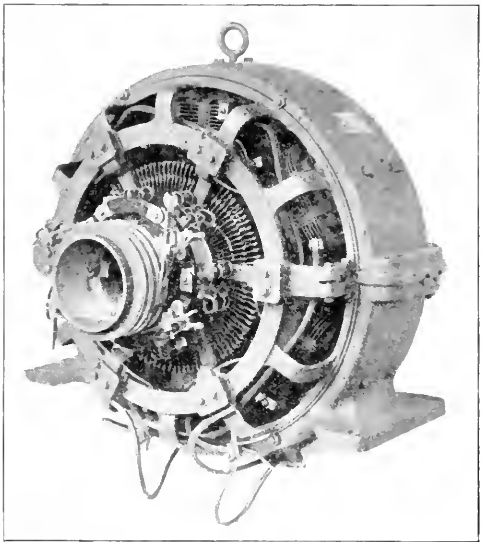
The Benjamin Electric Manufacturing Company have issued industrial lighting bulletin No. 10. In addition to the usual listing it includes several introductory pages covering choice of reflectors, design of illumination and the spacing of outlets to assist in making a lighting installation. Some of the more important new devices are the deep bowl reflector sockets, adjustolites, drop cord sockets and lamp grips for the prevention of loosening or falling lamps.

The Westinghouse Electric & Manufacturing Company have issued a number of interesting descriptive motor leaflets. No. 2441 is devoted to points of importance in the application of small motors, including the various questions of mounting, method of drive, and lubrication. No. 2443 gives performance curves of d.c. series wound and a.c. wound motors. No. 2409 covers self-starting synchronous motors in capacity from 50 to 1500 horsepower, and from 200 to 6600 volts. Type CA alternating current motors, such as are used for operating washing machines, vacuum cleaners, food choppers, adding machines, sign flashers, house pumps, and similar applications, are described and illustrated in No. 2362. The type OK electrically operated brakes for direct current crane and hoist motors are described and illustrated in No. 2446. No. 2449 describes types 536 and 537 hand operated controllers for light crane and hoist service. These controllers are built in sizes from 1/2 to 7 1/2 horsepower. Type SP electrically operated brakes designed especially for mill and crane service, built in sizes from 5 to 200 horsepower are described in No. 2447. Westinghouse alternating current steel mill motors (type MA) are fully illustrated and described in No. 2383.

INDUSTRIAL

WESTINGHOUSE THREE-WIRE DIRECT CURRENT GENERATORS.

Three-wire systems for the distribution of electrical energy at low voltages, direct current, were developed during the pioneer period of the art of electric lighting. They have been and are now used extensively for energy distribution for light and power over short distances, principally because of the copper economies that they effect. Current is transmitted at twice the voltage of the lamps or the other apparatus connected between the neutral and one of the outside wires. The neutral wire carries only the unbalanced current, the value of which is determined by the difference in the loads on the two "side circuits" of the system. The transmission of current at twice the receiver voltage results in saving of copper cost, with a given energy loss in the line, of nearly two-thirds as compared with the copper cost of a two-wire system of a voltage equal to the lower of the two three-wire system voltages. The half voltages obtained from either side of the system is often convenient for variable speed motor operation. Power consuming devices, motors especially, can also be connected across the higher of the two voltages.

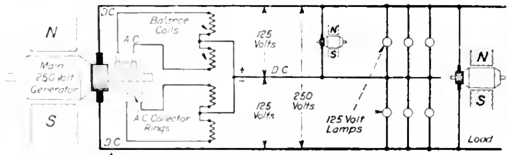


Westinghouse Type Q, Commutating Pole, Three-Wire Generator, Showing Collector Rings.

The decided advantages of a self-contained three-wire machine for operating three-wire systems as well as the commercial and engineering advantages of a three-wire balanced voltage system many years ago induced the Westinghouse Company to develop a three-wire balanced voltage generator. The method is of interest at this time because of its recent application to modern commutating pole dynamos.

With the addition of certain parts, any regular Westinghouse single-voltage, direct current generator can be adapted to provide three-wire voltages. The Westinghouse three-wire system retains all of the essential advantageous characteristics of the ordinary three-wire system; in addition, it has the important advantage that only one machine is required. It utilizes a simple arrangement for obtaining inherently balanced three-wire systems. The principal difference between Westinghouse three-wire generators and standard, single-voltage, direct current machines is that, with the three-wire dynamo, auto-transformers or balance coils are added and certain connections to the balance coil windings are provided, as shown in the diagram.

The devices that convert the machine from a two-wire to a three-wire generator are so small that a Westinghouse three-wire generator is almost as compact as a two-wire machine of equivalent output. Collector rings are mounted at one end of the armature and the connecting leads to them are similar to those employed on the alternating current side of a rotary converter armature. The superiority of a three-wire generator, which is merely a standard two-wire machine with certain simple parts added to its armature, over a complicated arrangement involving special armature windings is apparent. Some types of three-wire generators have armatures with special windings imbedded therein under the usual winding. Such windings are difficult of access and are expensive to repair.



Connection Diagram of Westinghouse Three-Wire Generator.

The balance coil (sometimes called auto-transformer), is connected across each pair of two-phase collecting rings. This balance coil consists of a single winding on a laminated iron core, and is similar in mechanical construction to a distributing transformer. The assembled coils are contained in a cast iron case similar to those employed for transformers. The middle points of the balancing coils are interconnected, and from this connection the neutral lead of the three-wire system is brought out as shown in the diagram. The superiority of a stationary balance coil, that can be located in almost any convenient place adjacent to the generator, over a balance coil installed within and rotating with the generator armature, is apparent.

The performance of the Westinghouse three-wire generator is practically identical with that of a two-wire generator. The losses in the balance coils are so small as to be negligible. The inherent regulation of the machines is excellent. Standard three-wire generators are wound for 125-250. They may be compounded to impress an increasing voltage with an increasing load, as is the usual practice with single-voltage machines. It is customary to divide the series field turns into two parts, connecting one part in the positive and the other in the negative line lead in order that the regulation may be preserved at all leads. Commutating poles assure sparkless commutation from no load to heavy overloads.

The three-wire direct current system finds its application in the distribution of energy for light and power in office buildings, machine shops, stores, manufacturing establishments, and in all installations where the receiving apparatus is located within a mile or so of the generator.

Three-wire generators may be operated in parallel as satisfactorily as two-wire machines. The balance coils are connected directly to the collector rings, and the neutral wire is carried to the switchboard. It is therefore unnecessary

to synchronize or connect the alternating current sides of the armature in parellel; nor it is necessary to consider the frequency of the alternating currents generated in the armatures of the different machines. Three-wire generators can be operated in parallel irrespective of the number of poles and speed of each just as easily and simply as two-wire generators can be regulated for equal voltage. Two-wire and three-wire generators can be operated in parallel with each other and the latter will handle any unbalanced load.

In large stations with many units, it is, therefore, only necessary to operate one three-wire generator, provided it has sufficient capacity to carry the difference between the loads on the sides of the system. All of the other machines may be of the single-voltage type. It is, however, advisable to install duplicate three-wire units each of suficient capacity to provide for the maximum unbalanced condition of the system.

It is standard practice with the Westinghouse Company to furnish balance coils of sufficient capacity to properly care for a 10 per cent difference in load on the two sides of the generator; that is, for 10 per cent of full load current in the neutral wire. Balance coils can, when specially ordered, be provided for much greater unbalancing.

Westinghouse three-wire generators can be furnished in any capacity, type, or voltage that has been standardized for ordinary two-wire service. The only difference between the two-wire and three-wire generators is that collector rings, brush, gear and connections to the armature winding are added in the three-wire machines.

A NEW FUSE FOR POTENTIAL TRANSFORMERS.

The General Electric Company has placed on the market a potential fuse which will open the circuit successfully under excessive current conditions, when connected to systems of large capacity, with the action accompanying the blowing so slight as to be scarcely noticeable. There is no flame or other external disturbance. Because of this fact there is no danger to adjacent apparatus, and the fuse may consequently be located in any convenient position, near the switchboard or elsewhere, no cells or barriers being necessary.

In appearance this fuse resembles the ordinary type of enclosed fuse, the fuse proper being a small wire which passes through the center of the fibre tube which is $1\frac{1}{2}$ in.

6600 and 15,000 Volt Potential Transformer Fuse.

in diameter. The wire is soldered at each end to the center of a metal cap, which is placed over the end of the tube. Surrounding the fuse wire is a filler which absorbs such a per cent of the arc, that the blowing of the fuse causes no external disturbance. The metal caps are provided with vent holes, so arranged that the filler will not leak out.

The performance under short circuit or with abnormal current on the line is independent of kilowatt capacity of the bus.

This fuse is intended primarily for use on instrument transformers. It can be furnished with special mountings to make it applicable to any use conforming with its voltage and ampere rating.

It is made for voltages up to 15,000 volts.

TRADE NOTES.

The Electric Appliance Company of San Francisco is moving its offices and salesrooms to 807 and 809 Mission street, where they have a six-story and basement building to accommodate their growing business.

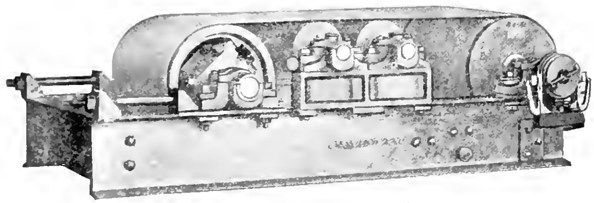
The General Electric Company has sold the Portland Railway, Light & Power Company a 7500-kw. turbo-generator rated as follows: One A.T.B. 2, 7500-kw. (9375 kva., .8 power factor), 1980 r.p.m., 5500 v., 3 phase, 33 cycle, horizontal Curtis turbine generating set. Also, under the same contract, an auto transformer as follows: One W.C.T., 5114 k.v.a, 11,000 v. primary, 5500 secondary.

In connection with the annual meeting of the League of California Municipalities at Berkeley, California, in September of this year, it has been suggested that all companies interested in street illumination prepare an exhibit of apparatus and equipment. This should appeal not only to the manufacturing companies but also to the electric companies supplying such service. Full details regarding the coming convention may be secured from the secretary of the League of California Municipalities in the Pacific Building, San Francisco.

The General Electric Company reports the following sales: To the Power Specialties Company, two small turbine generator sets, which are to be used for driving motors in two new municipal garbage disposal plants at San Francisco. Each set is described as follows: One 75 kw., 3300 r.p.m., non-condensing Curtis turbine, direct connected to one C. C. 4, 75 kw. 215-v, 250v. generator. To the Sierras Construction Company, San Bernardino, Cal., a 5000 kw. turbo generator set, as follows: One A. T. B. 4, 5000 kw., 1800 r.p.m., 6600v. generator, direct connected to one 5000 kw. horizontal, Curtis steam turbine. Also in the same contract, one 75 kw. Curtis turbo generator exciter set operating at 3300 r.p.m. Also, a motor generator set, as follows: One D. L. C. 6, 100 kw., 900 r.p.m., 125-v. D.C. generator, mounted on a common base with and direct connected to one I. S, 150 h.p., 44-v., 60 cycle, 3-phase, induction motor.

NEW HEAVY DUTY MAGNETIC SEPARATOR.

In many lines of manufacture it is very desirable to separate magnetic material from the non-magnetic. The cement industry is an example and the magnetic separator shown in the accompanying illustration has recently been in-



Cutler-Hammer Magnetic Separator.

stalled at the plant of the Southwestern Portland Cement Company, El Paso, Texas, for taking out stray iron, steel, etc., from the coal which is used in the kilns. This separator, built by the Cutler-Hammer Clutch Company of Milwaukee, is of somewhat special design. The pulleys are mounted on an I beam frame and because of the weight of the coal fed to the pulley, two idler pulleys are mounted between the wooden tail pulley and the magnetic pulley, which is at the right end. As the belt turns the coal is thrown to the front of the magnetic pulley and conveyed away, while the magnetic material is attracted and snapped off below, entirely separated from the coal. The current used for energizing the enclosed brass-jacketed coils brushes which are shown resting on the slip rings on the extension of the pulley shaft.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—The promoters of the Seattle, Kenwood & Lake Forest Railroad have filed articles of incorporati n. The line is to run between here and Bothell and Tolt.

COLFAX, WASH.—The Whitman County Cons lidated Telephone & Telegraph Company of Colfax, $100,000, by G. T. Smith and E. J. Byrne.

LOS ANGELES, CAL.—The Lompoc Gas & Electric Company, $100,000, subscribed $3, by L. J. Christopher, J. B. Mullen and M. Gunsul.

VANCOUVER, WASH.—Articles of incorporation of the Independent Electric Company have been filed by H. G Fleischhauer of Portland, H. K. Lugger of Vancouver and M. F. Brady of Portland. The capital stock placed at $50,000. Vancouver is the principal place of business. Its object is to operate and maintain the business of generating electricity tor light and heating power to cities and towns in Washington.

SAN BERNARDINO, CAL. Articles of incorp ration have been filed for the Limited Mutual Water Company, with a capital stock of $20,000. The company is organized to supply water to the district bounded by San Bernardino avenue, West Fourth street, Mountain avenue and the south side of the right of way of the Santa Fe in the vicinity of Ontario. The direct rs are: J. W. Squire, C. W. Churchill and J. E. Burnham.

ANAHEIM, CAL. Articles of incorporation of the Anaheim City and Interurban Railway Company will be filed for record in a few days, according to William Gerdes of South Los Angeles street, who is associated with L s Angeles and Eastern capitalists in construction of a network of interurban railways radiating from this city. The company will be incorporated for $500,000. Mr. Gerdes states that they intend to be operating cars on the line between Anaheim and Fullerton within a year after receiving franchises, which are to be asked through Fullerton, Orange and Santa Ana.

ILLUMINATION.

EL PASO, TEX.—A gas holder to cost $35,000 is to be erected at once by the El Paso Gas & Electricity Company, to have a capacity of 500,000 cubic feet.

LYNDEN, WASH.—An ordinance has been passed granting to the Lynden Mill & Light Company the right and authority to operate an electric plant for the generation, transmission, distribution and furnishing of light and power to the said town.

BURBANK, CAL.—Bids will be received up to May 25, for a franchise to build and construct, maintain and operate for a period of 40 years, an electric light and power system under and along the public streets, alleys, avenues and highways of the city of Burbank.

FAIRFIELD, CAL.—The Solano County Supervisors have granted a franchise to the Great Western Power Company. A resolution was passed to print authorizing the county clerk to advertise for a contract to furnish power in Solano County which would include a rate of 1c per kw. for the county buildings. Bids for such franchise are to be opened June 3.

VALLEJO, CAL.—A temporary franchise has been granted by the City Council to the Great Western Power Company to install power lines and supply electricity to the people of Vallejo. The company asked for a 35-year franchise. A $2000 check accompanied the application. The franchise as presented allows the commissioners the privilege of fixing the rates to be charged consumers. At the end of 35 years the city could purchase the equipment of the company. The application was placed on file.

SEATTLE, WASH.—Chairman George A. Lee, Jesse S. Jones and Harry E. Wilson, of the state public service commission, took testimony this week in connection with the commission's proposed gas, water and electric light rules. Forty representatives of various utilities in different parts of the State attended the hearing. Chairman Lee, commenting upon the hearing, said: "We have now had presented final objections to the commission's gas, water and electric light rules. These rules regulate the testing of meters, rendering of bills, the quality of gas, water and electricity, the question of advance payment of bills, dep sits and other items of vital importance to the consumer. Machinery for testing gas, water and electric meters is required and fees therefor fixed. We believe that many causes of complaint against public srvice companies will be removed by these rules, and that better public service will be the direct outcome. Representatives of public service corporations who attended the hearing of the commission recently included the following named: A. B. Eilbeck, vice-president Spokane Gas & Fuel Company; M. L. Driscoll, city attorney, of Pasco; T. L. Keeley, Tacoma Water Supply Company; F. C. Farmer, Kitsap County Telephone Company, Bremerton and Port Angeles Telephone Company; F. C. Brewer, Bremerton & Charleston Light & Fuel Company, Grays Harbor Gas Company, Centralia & Chehalis Gas Company, Port Angeles Water Supply Company; A. M. Chitty, Puget Sound International Railway & Power Company, Everett; James E. Wickstrom, Shelton Electric Company and West Coast Power Company; J. S. Crilly, Blaine Water Company; E. R. Ramsey, Pittsburg Meter Company; C. C. Turley, Portland Railway, Light & Power Company; Victor H. Greisser, the Washington Water Power Company; George L. Raymond, Raymond Light & Water Company, Raymond, Wash.; M. Manly, White Salmon Water Company; L. M. Sims, Orchard Water Company, Kalama; C. W. Hodgdon, Hoquiam; C. M. Fassett, commissioner public utilities, Sp kane; Charles E. Shepard, president Light & Water Works, Montesano and South Bend; H. B. Zimmerman, Grays Harbor Railway & Light Company; J. S. Thornton, Twin City Electric Company, Raymond; Douglas Allmond, Anacortes Water Company; Wilbur B. Foshay, Washington-Oregon Corporation, an electric, gas, water, telephone and tracti n company; M. D. Spencer, Everett Gas Company, of Everett and Snohomish; J. E. Davidson, Pacific Power & Light Company, Portland.

TRANSMISSION.

LA GRANDE, ORE.—The Western Oregon Light & Power Company has been granted franchises by Elgin, Immler and Alicel, and will extend a line from here.

RIALTO, CAL.—Bids will be received up to May 21 for a franchise to erect and construct and operate for fifty years an electric pole, tower and wire system for transmitting electrical power along and upon all public roads, streets and alleys of the City of Rialto.

AUSTIN, TEX.—The Guadalupe Water Power Company of Seguin, Tex., recently formed with a capital stock of $600,000, will construct a series of dams and hydroelectric plants upon the Guadalupe River between that place and New Braunfels. The same interests are arranging to form a company for the purpose of constructing an interurban electric railway between Seguin and New Braunfels and between New Braunfels and San Antonio. The power of the hydro-

electric plants is to be used for operating the two railways and power transmission lines will also be constructed to San Antonio, New Braunfels, Seguin, San Morales and other towns in that section. The Guadalupe Power Company has already purchased the water power rights on the Guadalupe River and has surveys made for the six dams. It has expended already in preliminary work about $300,000.

OROVILLE, CAL.—Work has been started by the Great Western Power Company on its dam at Big Meadows. This work is to be completed by the first of the year. The Big Meadows will then constitute the largest artificial lake in the world. By the construction of this dam more than 55,000,000,000 cubic feet of water can be stored for power and irrigation. The company announces that it proposes to make five developments of power between Big Meadows and Oroville. This will necessitate the construction of four additional power plants at an investment of approximately $20,000,000. The total capacity of the plants will be 600,000 h.p. The Big Meadows reservoir will make available a supply of water sufficient to irrigate 500,000 acres of land. This water will be available for use at Oroville and will suffice for a tremendous addition to the orange and olive industry in Northern California.

LOS ANGELES, CAL. In response to the appeal of E F. Scattergood, chief electrical engineer of the aqueduct power bureau, for immediate action and in accordance with the ideas of Mayor Alexander, the Board of Public Works has authorized preliminary steps to be taken relative to the installation of a municipal power distributing system. In a report to the board, Engineer Scattergood suggested that all companies having conduit or pipe lines in the streets of Los Angeles be required to file with the city engineer complete and accurate maps, giving a description and showing their location, and recommended that the city compile a set of composite maps on the scale of 25 feet to the inch, showing on each portion of these sectional maps all conduits and pipe lines accurately located. The board referred Scattergood's report to City Engineer Hamlin, with instructions to report what procedure should be followed and to submit an estimate as to what the cost will be to prepare such maps and plans as suggested. President Hubbard and Commissioner Humphreys of the board estimate that it will cost about $25,000 to prepare the maps and plans desired by the power bureau. Mayor Alexander has been under the impression a bond issue of about $5,000,000 will be necessary with which to establish the proposed municipal distributing system for power and electricity. He has suggested that this bond election might be held next December, without violating the contract with Speyer & Co., the New York bond firm.

TRANSPORTATION.

WEISER, IDAHO.—It is reported that the Southern Idaho Light, Heat & Power Company, owner of the interurban railways, out of Boise, will have its line completed from Caldwell to this place within another year.

EL PASO, TEX.—A bonus of $16,000 has been paid to Stone and Webster, owners of the El Paso Electric Railway Company, to insure building of a street car line on Stanton street, between the Boulevard and San Antonio street

MEZA, ARIZ.—At the election for determining whether a franchise should be granted the Salt River Railroad, 72 votes were cast in favor of the franchise and 55 against. This means work will commence at once as the company has promised to have cars running within eighteen m nths.

SAN DIEGO, CAL.—G. W. Pursell, promoter of the San Diego, El Cajon & Escondido Railroad, has sounded the City Council for extension of his franchise. Operation of cars originally was to begin June 1, which is considered an impossibility. Actual construction will be resumed within thirty days, it is said, and city lines will be hurried to completion. It is probable the extension will be granted the Los Angeles, Riverside & San Diego Railroad, as successors to the old company.

SAN BERNARDINO, CAL.—A franchise for an electric railroad to extend from the city limits along Rialto avenue to the Southern Pacific station has been asked for by the Pacific Electric Railway, and the City Council has ordered a call for bids. The franchise is for both freight and passenger service and covers a period of 50 years.

ANTIOCH, CAL.—A corps of engineers for the Oakland, Antioch & Eastern Electric Railroad have been at work here for several days surveying along the main street. Although the men have been engaged in running lines between this place and Pittsburg for some time, this is their first appearance within the corporate limits for several months. It is believed that the company will ask for a franchise through the city in the near future. There is strong indication that the road from Antioch to Bay Point will be constructed this summer.

AUBURN, CAL.—G. B. Herrington, who built the Mountain Quarries Railroad from this place to the Mountain Quarries Company's quarry, on the American River, is canvassing among the citizens and business men of Auburn, with a view to get them to subscribe the necessary capital to build and equip a line of electric street railway in this city. Mr. Herrington says that if the money needed, $30,000, is subscribed by the pe ple of Auburn, a company will be formed and a franchise asked for, and as soon as possible construction work will be commenced. The proposed line will run from Aeolia Heights on the eastern limits of the city to the new Southern Pacific depot on Nevada street and will pass all the hotels, principal business houses, the opera house and churches and the courthouse, and the entire length of the road would be nearly two miles. It is proposed to have a high power car make regular trips at 20 minutes interval, from one end of the town to the other, over the principal streets, and meeting all passenger trains at both depots.

TELEPHONE AND TELEGRAPH.

LAPWAI, IDAHO.—The Pacific States Telephone Company has asked for a franchise and will expend $5000 in installing their system here.

KLAMATH FALLS, ORE.—The Pacific Telephone & Telegraph Company is soon to begin the construction of a new telephone system for this place.

HOLLISTER, CAL.—Messrs. Fox & Zimmer of the San Benito oil fields state that the oil company will construct a telephone line from Section 5 to King City.

SANGER, CAL.—The Board of Trustees passed an ordinance granting a franchise to the Sanger Telephone Company to construct and operate a system of masts or poles and wires for the transmission of electricity for telephone purposes in Sanger.

SEATTLE, WASH.—In the case of the Puget Sound Independent Telephone Company against the Pacific and other companies, where certain long distance connections and rates were sought, the parties have reached a compromise which will give Snohomish, Skagit and Whatcom counties long distance service to Seattle and Tacoma. This agreement was made subject to the approval of the commission and fully satisfies the complaint.

TACOMA, WASH.—Mayor Seymour is desirous that Tacoma shall own its telephone system after the Pacific Telephone franchise expires three years hence. Last December the Home and the Pacific systems consolidated. Two weeks

ago Mayor Seymour and the city commission revoked the Home Telephone franchise, allowing the company 60 days to remove the wires and poles and transfer the conduits to the city. The company has taken no action. Under the Mayor's instructions, the city attorney prepared papers for quo warranto proceedings against the Pacific company to compel them to cease the maintenance of the Home company's lines and to remove its poles. The revocation of the Home franchise is based chiefly on the discontinuance of the automatic service which it called for. The city's chief aim is to completely nullify the Home franchise so that the Pacific Telephone Company cannot operate under it after 1915.

OLYMPIA, WASH.—That there is a big difference between the figures of the company and of the State's experts in regard to the cost of telephone service in Olympia; that the company had two sets of contracts; that the cost of telephones in Olympia increased in 1911, compared with 1910, while in the country there was a decrease, were some of the things developed at the hearing before the Public Service Commission on the complaint of the Farmers' Telephone Company of Thurston county against the Pacific Telephone & Telegraph Company of Olympia. The rural company charges that the Bell company is acting in an unreasonable manner in increasing its rates from $3.60 a year for each rural telephone to $7.20. The Bell company's agents asserted that the cost per station of operating in Olympia is $9.12 annually. A. R. Kelly, telephone expert for the Commission, testified that an examination of the company's books in San Francisco showed that in Olympia in 1910 the cost was $6.36 per station and in 1911 had increased to $7.48. On the other hand, he testified that the cost per station for the farmers' telephones was $4.19 in 1910 and only $4.06 in 1911.

SAN FRANCISCO, CAL. The Postal Telegraph Company has filed a complaint with the State Railroad Commission against the Pacific Telephone & Telegraph Company and the Western Union Telegraph Company. The complaint was informal and was contained in a letter to the Commission from W. Hearn, local manager of the Postal. The protest charges discrimination. It is set forth that the telephone company has been in the habit of switching calls for the Postal to the Western Union. The complaint says that on March 15 a series of tests was made in San Francisco, Berkeley, Sacramento and Fresno. It is declared that after calling for the Postal company the subscribers were connected with the Western Union. The Pacific Telephone Company and Western Union have an arrangement by which a subscriber calling for "telegram" is connected with the Western Union. The Postal company asks that the telephone company be directed to change this system, to the end that when the subscriber calls "telegram" the central operator must ask the subscriber whether he wants Western Union or Postal. The Pacific Telephone Company has been called upon by the Commission to reply.

SAN FRANCISCO, CAL.—The State Railroad Commission has notified the Pacific States Telephone & Telegraph Company that it must correct immediately all inequalities in its rates. The board also demanded withdrawal of certain rate advances made late in 1911. Since the date on which the constitutional amendment relative to the State control of public utilities went into effect, the telephone company announced certain reductions in rates in and about Hollister, Stockton and other cities. In the main, these reductions were said to amount to discrimination against new subscribers in favor of the old. A new general rate for new subscribers was established, and at the same time old subscribers were given a rate lower than the general. Under the public utility act, the company had no right to make these advances or reductions without applying for the Railroad Commission's permission. A hearing recently, at which the Pacific States was represented by E. S. Pillsbury, resulted in the Commission ordering the telephone company to cease the overcharges at once, iron out all inequalities and, at the same time, file with the Commission a copy of all its tariffs. It has already filed a general schedule of rates, but not one by which the Commission could discern the difference between the metropolitan, general and suburban rates, or compare the differences.

LOS ANGELES, CAL.—The long fight which the city of Pomona, aided by Los Angeles and Pasadena, has waged against the Sunset Telephone & Telegraph Company for the municipality ended when the United States Supreme Court reversed the decision of the United States Appellate Court and declared that a municipality has the right to charge a corporation for the privilege of doing business in the community. All claims that a corporation such as the Sunset has the right to do business in the city because it operates a telegraph line which is subject to government use in time of war, fall flat, according to the decision of the Supreme Court of the United States. A corporation doing business in a city must take out a franchise in order to use the public streets for the purpose of stringing wires, laying gas mains or running street cars. Also the municipality has the right to charge the company a certain per cent of the net income for the privilege of such a franchise. The decision of the Supreme Court of the United States is of the utmost importance to California as well as the rest of the United States. There is no doubt but that the opinion handed down will mark a precedent in the legal procedure of the country, for there are suits in nearly all parts of the country in which corporations are seeking to avoid paying municipalities for using the city streets and public thoroughfares. The fight to force the Sunset Telephone & Telegraph Company to take out a franchise started ten years ago.

WATERWORKS.

BRIGHAM CITY, UTAH.—The $35,000 bond issue for the construction of waterworks carried by a large majority at the election recently held.

MONMOUTH, ORE.—Bids will be received up to the 4th day of May for furnishing the material and labor and constructing a system of waterworks for this city.

WAPATO, WASH.—Bids will be received up to the 8th of May for the furnishing of all material and labor necessary for the construction of the distributing system of the municipal waterworks.

LOS ANGELES, CAL.—The City Council has referred to its water committee the recommendations of City Attorney Shenk for immediate installation of an adequate water service at Terminal Island.

MODESTO, CAL.—The plans and specifications of the proposed water system have been adopted and placed on file and the appointment of F. C. Roberts and E. H. Denicks as supervising engineers confirmed.

SEATTLE, WASH.—A special election has been called for April 27th to vote on the construction of a new water system, to be owned by the city. Water will be brought from Deer creek, one mile west, by gravity.

PECOS, TEX.—It is proposed to have a special bill passed at the next legislature allowing Pecos to issue special municipal bonds for the purpose of constructing a waterworks system to cost about $90,000. Water is to be carried a distance of 14 miles.

BAY CITY, ORE.—Bay City is to have a new water system during the coming summer. Plans are now being drawn by the Bay City Land Company to replace the entire plant. Six-inch mains will be laid in the business district. It is estimated that $5000 will be spent on the system.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

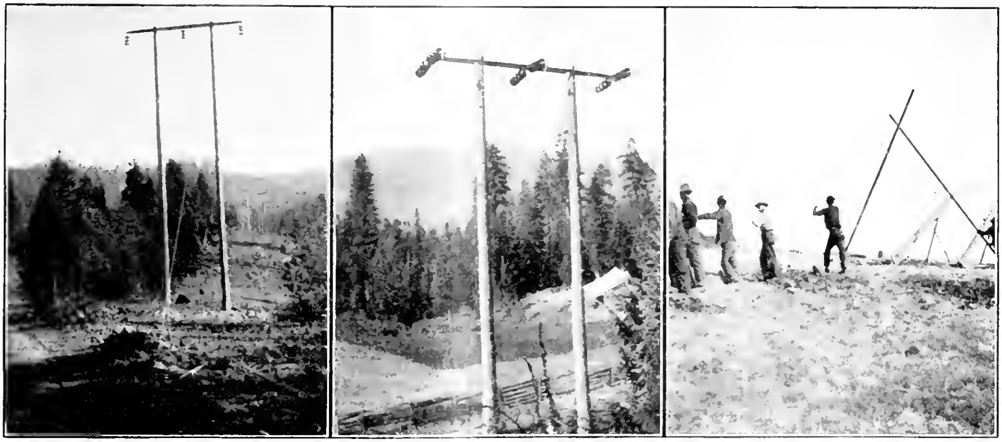
VOLUME XXVIII — SAN FRANCISCO, MAY 4, 1912 — NUMBER 18

NOVEL WOODEN TOWER LINE CONSTRUCTION

BY O. G. STEELE.

The manner and method of constructing the 60,000 volt wooden tower line of the California-Oregon Power Company involves several unique features which make a description and detailed cost statement of considerable engineering interest.

This transmission line is 24.6 miles in length, connecting the Fall Creek power plant of the California-Oregon Power Company, about 2½ miles south of the California-Oregon line, with the town of Ashland in Southern Oregon. It ties in with the extensive system which the company has recently acquired by the consolidation of the Siskiyou Electric Light & Power Company, the Rogue River Electric Company and surrounding plants.



Wooden Pole Towers Showing Method of Erection.

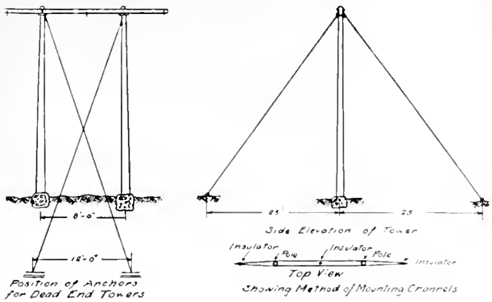
The plants in operation in this system are the Fall Creek plant in Siskiyou County, California, the Gold Ray plant in Jackson County, Oregon, and the Prospect plant at Prospect, Oregon. The former plant is situated on Fall Creek, a tributary of the Klamath River and is about one-half a mile from the mouth of that river and within one hundred yards of the Klamath Lake Railroad. The two latter plants are both on the Rogue River. In addition to these three plants there are also two hydroelectric plants at Klamath Falls on the Link River and the Shasta River plant four miles north of Yreka, Cal.

Construction work is also being rushed to complete the first two 10,000 kw. units on a new installation on the Klamath River about a mile and a half east of the Fall Creek plant. Since the Fall Creek plant is very nearly the geometric center of the system, as seen from the map, it will handle the dispatching for the entire system.

The Fall Creek plant, constructed during the winter of 1902-1903, being the first generating station of the company, has an interesting history. This plant as completed in 1909 has a capacity of 3200 kw., which energy is generated at 2300 volts, 60 cycles per second, three-phase. It is then transformed to 22,500 volts delta for transmission.

Four lines are run out of Fall Creek to various parts of the country. Line No. 1 takes a southerly course to Etna Mills, a distance of 55 miles, tapping Hornbrook, Yreka, Montague, Ft. Jones and Greenview. Enroute, mines are electrically supplied on the Klamath River, Humbug, Cherry Creek, McAdams Creek, Indian Creek, Patterson Creek, Oro Fino and Quartz Valley.

Transmission Lines of California Oregon Power Co.



Details of Tower.

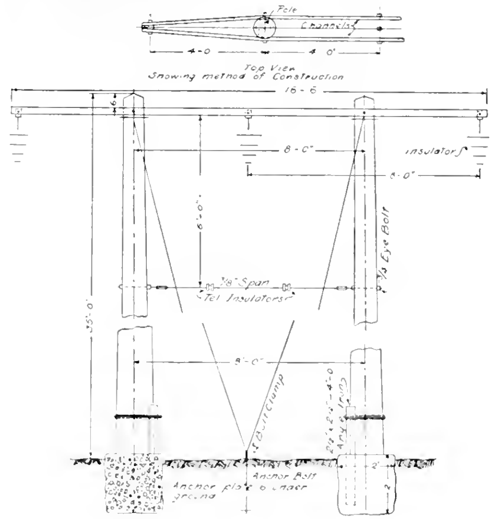
Line No. 2 runs due south to Castella, a distance of 75 miles, passing through Dunsmuir, Sisson, Weed, Big Springs and Shasta Valley. Line No. 3, on the other hand, takes a northwesterly course 24.6 miles to Ashland, Ore., where it connects with the Rogue River system. Finally, line No. 4 completes the points of the compass by taking a course due east to Dorris, 23 miles distant, thence north to Klamath Falls, a distance of 20 miles.

The first two lines mentioned are of the ordinary single pole construction, line No. 1 being constructed for 30,000 volts and line No. 2 for 60,000 volts, single circuit, three-phase. Lines No. 3 and No. 4, however, are of the two-pole type set on concrete bases and anchored at the front and rear as shown in the illustrations. Spans vary from 450 to 1000 feet., one span being 1465 ft. across Jennie Creek Canyon.

Concrete Bases for Poles.

Cast iron anchor plates were used in the foundation work while 3 in. channel iron was employed for the cross-arms. These arms are 16.6 ft. long and are painted with P. & B. paint to prevent rusting. Angle iron $2\frac{1}{2} \times 2\frac{1}{2}$ in. was used to bind the poles to the concrete bases shown in the illustration. Insulators of the Locke suspension type are employed. Each insulator, composed of three units, clasps the conductor by means of a straight line clamp. At the point where angles are necessary in the transmission line four units are employed in the insulator.

Every fifth tower is so constructed as to take up the strain at these strain towers, four anchors are employed with guy wires crossed, while for standard towers only two anchor plates are employed.



Details of Tower.

The raising of the towers proved an interesting problem due to the roughness of the country encountered. While the hillside, composing a portion of the transmission line made only one method applicable, it was not at all times practicable to deliver the tools required. In the illustration one of the best methods of performing this is shown in which a crew of twelve to fifteen men are employed.

The poles are first placed on supports about seven feet above the ground. The guy wires are next passed over the fork as shown and with the aid of a block and tackle the poles are pulled into place, during which process men with pike poles properly guide them. After the poles are thus set on their bases, the guys are pulled through the eye of the anchor rod and simply tightened by hand, another crew following the first one put the guy wires in final taut condition. Later in the progress of the work, it was found that a horse could be used to raise the towers and this method proved satisfactory. As many as twenty-five of these towers may be thus raised in one day. Referring to the guy clamps, the ordinary three-bolt galvanized type was employed but in the future the combination clamp will replace the three bolt design.

An average of ten towers per mile were necessary in the construction of the transmission line, although this varied somewhat wherever rolling country prevailed. Thus in crossing canyons, spans were made of full length in most cases. The country through which lines No. 3 and No. 4 pass is rough and in the construction it became necessary to use pack mules in the delivery of cement, water and other material along the line.

In dead ending the towers the conductors are passed over the straight line clamp direct to the anchor plates in the ground, the suspension type of in-

sulator here used necessitated four units of suspension.

The unit cost of construction of such a line has been estimated to be about as follows, assuming 10 towers per mile:

Average Cost Per Mile of Wood Tower Transmission Line. 10 Towers Per Mile, 21.6 Miles.

Wire 3 No. 2 Copper, 3242 lb.	@ $0.155	$502.51
Wire 2 No. 9, Iron, 1053 lb.	.05	52.65
Insulators, 100 suspension units	.775	77.50
33 suspension eyes	.125	4.13
7 strain clamps	.74	5.18
30 straight line clamps	.364	10.91
Channel Iron Arms, 10 sets of 2, 132 lbs	.033	43.56
Angle Iron, 338 lbs	.0298	10.00
Cement, 4.35 bbls	3.74	16.30
Gravel, 6.3 yds.	.25	1.57
Telephone Insulators, 21 No. 26	.05	1.05
Pole line Hardware 24 bolts ⅝ x 8 in.	.088	20.00
20 bolts, ⅝ x 1¾ in.	.0368	7.72
50-3 bolt ⅜ in. guy clamps	.151	7.55
50-½ in. thimbles	.0312	1.56
250 ft. ⅜ in. strain guy cables	.016	40.00
25 guy rods, ½ in. x 6 ft.	.36	9.00
450 lb. anchor plates	.03658	16.36
Poles, 20-40 ft. red fir	1.629	32.58
Right of Way, average cost of securing		16.85
Camp outfit and tools, proportional cost per mile		20.00
Total		$896.78
Labor:		
Surveying right-of-way		$ 64.00
Clearing right-of-way		148.20
Hole digging, 20 foundation holes, 2 ft. deep and 25 guy holes, 5 ft. deep		79.60
Powder		6.95
Tower framing, 10 towers	@ 2.29	22.90
Haulage, including cost of teams, hay and grain:		
20 poles, average 2 miles	@ 3.037	60.74
Wire, average cost per mile		20.51
Channel iron arms including painting		14.50
Foundation materials		25.80
Setting 20 foundations (concrete)	@ 5.51	110.20
Raising 20 towers at	@ 5.538	110.76
Wire stringing 3 copper transmission and 2 iron telephone		73.60
Extras, blacksmithing, coal and labor		10.00
Warehouse man		4.00
Time-keeping and books		14.00
Superintendence		28.50
Total		$783.66
Miscellaneous:		
Camp expense, moving, depreciation in maintenance of automobile		$ 86.00
Loss on cook house after serving 11,930 meals at 35c		7.56
Numbering, repairing and distributing material for future repairs		25.80
Total		$ 109.36
Grand total		$1789.80

FUNDAMENTALS OF A COMPREHENSIVE TRANSIT PLAN.

At the annual public meeting of Alpha of Tau Beta Pi, the engineering honor society, at the University of California, Mr. Geo. A. Damon, engineer with Bion J. Arnold at Los Angeles and dean of the Throop Polytechnic Institute, delivered an address on the "Fundamentals of a Comprehensive Transit Plan."

In introducing the subject Mr. Damon illustrated the importance of adequate transportation to every community as the people pay more for passenger transit than they do for taxes, and more for street car fares than for all other public utility service combined. The tendency toward public regulation by State commissions, by local utility boards and by contract ordinances, was described and the importance of the public's knowing the fundamental truth as to the financial and technical requirements of the transportation problem was emphasized.

Mr. Damon then discussed a number of technical fundamentals which must be considered in working out a comprehensive transit plan for any city or district. The location and growth of the population was shown to follow the natural physical laws of expansion, contraction and crystallization. The spreading out from the first "origin" or center, the shape of the city as influenced by topography and the forming of satellite sub-centers was shown. The planning of good transportation was compared to the laying out of an electrical distribution system and the rapid transit lines were likened to the high tension feeders. The principle of "radials" and "circuits" for transportation main arteries and cross connections was explained. That transportation increased at a rate even greater than the square of the increase in population was shown to be a most important fundamental—as it demonstrated that the "riding habit" could be cultivated and that rapid transit would create a large amount of new business. The decrease in cost with the increase in density of traffic and the necessity of operating cars in trains in order to get the full benefit of the physical capacity of any line are important points in favor of establishing a zone system of construction and operation, consisting of subways in the congested district, fed by elevated or open cut lines in the next zone of population density and finally ending with a system of surface car lines for collection and distribution in the suburban districts. The constantly growing demands for the investment of additional money in transportation facilities was shown and the fact that when the population doubles the actual investment must be increased by from four to six times was brought out to show the importance of developing some system to protect this investment. The principles of public regulation of utilities were discussed—the securing of adequate service being put first, the protection of the actual investment at a a fair rate of return second, and the fixing of reasonable rates third. The duty of the engineer in taking a larger part in the problem of public control was pointed out and the contributions of the technical men in working out the principles of depreciation, obsolescence, decapitalization and amortization were referred to as examples of the problems which must be solved before we get the full benefits of scientific regulation.

The essential features of the address were then illustrated by a series of lantern slides showing the Arnold method of attacking a transportation problem —including dot maps showing the location of the "sleeping population," growth of population diagrams and charts, time zone maps to investigate rapid transit developments and rush hour seat and car diagrams to indicate the daily flow of traffic. Drawings and photographs of subways, elevated and open cut lines indicated the importance of making the transportation arrangements the back-bone of a modern city plan. A final diagram showed how the settlement ordinance of Chicago has resulted in a stable balance between the requirements for operating expenses, renewal fund, return on the investment and the division of the surplus between the city and the companies which had set a high standard in the evolution of transportation developments.

SOME FEATURES OF RATE FIXING FOR ELECTRIC PUBLIC SERVICE PROPERTIES[1]

BY GEORGE L. HOXIE.

Rate-fixing is one of the newer engineering problems. It is true that rate-fixing commissions have been, and are, largely composed of lawyers, but the members of all of these commissions have found it necessary to rely largely upon their engineering experts, and it seems to the writer entirely probable, as well as desirable, that the engineering profession should in the future have an increasing share in handling rate-fixing matters. It seems probable that for some time to come there will be a steadily increasing number of engineers either employed directly by commissions, or employed by public service corporations in connection with the work of commissions. It is therefore important that engineers should devote some attention to the problems of rate-fixing.

Rate-fixing is designed to accomplish three objects. First, that the people served by a public utility shall pay the lowest rate possible, consistent with efficient service and a proper return on the investment of the corporation. Second, that each class of consumers pay its proper proportion of the total revenues. Third, that there shall be no discrimination between individual consumers of any given class.

The third problem is not difficult. It is only necessary to pass laws forbidding discrimination and to see that those laws are not evaded. There is no difference of opinion as to the desirability of preventing discrimination, and there is little difference of opinion as to what constitutes discrimination.

The other two problems are difficult. Taking up the first question, it must be determined primarily what is a "proper return," and second, what constitutes "investment." We will consider to begin with the case of a successful public utility. (It is obvious that a utility that was not needed by the people served, or one that is operated at such cost that the people served cannot afford to pay a proper return on the cost, cannot be subjected to the same rules that apply to a successful utility.) The consumers served by a successful corporation can afford to pay, and should pay, annually a sum of money sufficient to cover:

(a) The usual rate of interest on safe investments.

(b) An additional sum to compensate for whatever special risk the business of the public utility may involve; and

(c) Such excess profits as are necessary to induce capital to engage in the business.

Item (c), covering profits necessary to induce capital to engage in the business, is somewhat akin to item (b) and in fact the two items might be combined, yet there are some real differences and it has therefore been thought proper to include the third item, covering inducement. Capital is usually induced to engage in a business by a promoter. Item (c) may therefore be thought of as represented in part by promotion stock, or by the earnings of promotion stock.

[1]Abstract of paper presented to Engineers and Architects Association of Southern California, April 18, 1912.

What Is Investment

Investment may be in money, or in services. The latter is as real as the former. The fact that services have frequently been groosly over-valued has led to a feeling that the investment of services should not be permitted. This seems wrong. The services of the promoter, for instance, may usually best be paid in stock. This amounts to saying that the services of the promoter may be capitalized. The danger is of course that stock being sometimes simply a matter of the printing press, an excessive payment is made for promotion, and the public is thereafter charged with the necessity of paying dividends upon a large amount of water. Promotion stock in fact is not water unless it be issued to a greater amount than the actual services of the promoter justify.

In appraising a public utility just put together and ready to operate, the writer would include in the appraisal, besides figures representing the cost in place of each physical item, (cost of engineering, cost of insurance, etc.), also the exact cost of putting together the corporation, (cost of legal work, etc.), and besides these would include payment for the energy and initiative used on the scheme as a whole, under the head of "Cost of Promotion." All the items on the schedule added together would then be the true "Investment" when the entire plant stands ready to begin operation.

Franchise Value.

In most rate-fixing investigations the franchise itself is not permitted to be regarded as an investment on which earnings are made. This is not necessarily the case, however, as it frequently costs money to get a franchise, and the terms of the franchise frequently involve an annual expense to the company. For example it is not uncommon for an electric lighting company as a condition of its franchise to engage to supply electricity to various public buildings free of charge, or the company may as a condition of its franchise engage to perform street lighting at an especially low rate. Where any of these elements are found the franchise represents either a real legitimate initial expenditure, or a constant annual expenditure, and in either casĉ the franchise may reasonably be regarded as capital on which case revenues must be earned. In the latter case the expenditures may with equal justice be charged instead as operating expenses, if for any reason this is preferred as a matter of bookkeeping.

Going Value.

Assuming that we have decided what constitutes "investment' for an enterprise just completed and ready to operate; what is "investment" for "going concern?" It is rather obvious that a completely equipped utility company ready to operate, but having no customers, has a different value from the same utility a little later when we may assume that its total product is being sold at a remunerative figure. The difference in value between a company without customers and the same company under full operation may reasonably be considered as represented by the cost of putting the company into the latter condition; in

other words, the cost of establishing the business. This sum is represented by early losses, or by the failure to earn proper profits, in the early years of operation.

Depreciation.

There is a wide difference of opinion as to proper methods of figuring depreciation and even as to what constitutes depreciation. It will therefore be assumed that depreciation is figured on a straight line basis, using the assumed useful life of the various items making up the total investment as a basis for determining the yearly charge against each item to cover depreciation. It is also assumed that depreciation has only one value at a given moment for a given item. The items of cost of franchise if any, and the costs of general engineering, superintendence, insurance, law, promotion, going value, etc., should be subject to a depreciation charge as well as are the items covering actual physical property. This means, of course, that such intangible costs as those just enumerated are to be written off, or amortized, in the course of time.

The bookkeeping in connection with depreciation expenditures should be wholly under the control of the commission, that it may be made certain that no part of the plant, built with depreciation money, is capitalized, even though the depreciation fund proves in the course of several years, to have been larger than was really necessary. This, of course, applies to additions made under regulation and not to additions made out of surplus earnings before the advent of rate regulation.

If after determining a proper income to be allowed, it be found for a particular corporation that its stock and bonds have enjoyed a wide market, and have been generally distributed and would be considerably depreciated by the revenue proposed to be allowed, then it seems to the writer that a commission may reasonably allow weight to such a state of facts. On the one hand a strict ruling will bring an immediate loss upon the investor, and on the other hand if the strict ruling be not followed a loss is thrown upon the general public, by collecting from them higher rates than are necessary. A newly organized commission might very reasonably compromise by fixing a term of years at the end of which strict rulings will generally apply, and in the meantime gradually lower the rates during said term. Such a course does not correct past injustice, but it divides the losses resulting from injustice between the stockholder who has made an unfortunate investment, and the public that permitted the unfortunate conditions to exist.

Detail of Rates.

In the writer's opinion the revenue collected should be based ultimately upon the "present value" (reproduction cost, less straight line depreciation) of all physical and non-physical items of property necessary to the service sold. The revenue should be sufficient to cover operating expenses; depreciation charges; and income upon "present value."

It would seem at first sight that if an agreement be once reached on total revenue to be collected the rate problem would be practically solved. Such is by no means the case. It is hardly too much to say that some of the hardest problems still remain. These problems do not seem to be of such a nature that any general solution may be indicated, but they are well worth discussion.

For illustration, let us consider the case of a company whose sole business is the manufacture and sale of electricity. There are many public service enterprises that handle a far more complex business, but this will suffice for illustration. It would probably be found that such a company is retailing electricity in small quantities for domestic purposes; that it is supplying energy for small motors over a wide area; current for small stores scattered through the residence districts of town; lighting for apartment houses over quite a wide area; lighting for hotels and department stores in the business districts; street lighting, probably of at least two kinds; current for electric elevators; current for manufacturing; current for pumping water, and probably also current for operating electric railways.

Not only is every one of the classes of service mentioned supplied at different cost to the company, considering that particular class of load alone, but the cost of supplying each class is vitally affected by the presence of the other classes, i.e., by "diversity factor."

It will almost invariably be found that the public have no proper conception of the necessary difference in cost per kw.h. between supplying a householder with lighting current say to the amount of 20 to 30 kw.h. per month, current being delivered around 100 volts, and the current measured being used a short time per day while an unmeasured all day loss goes on in the customer's individual transformer; and the cost per kw.h. of supplying say 500,000 kw.h. per month, at say 10,000 volts, to a railway company. It is rarely pointed out that a company is fairly lucky if a kilowatt hour at 100 volts, measured inside a customer's residence, does not mean pretty nearly two kilowatt hours measured back on the high tension line.

The author inclines very much toward putting residences using current mainly for lighting, into a single class. Let us say that the shape of the daily load curve is about the same for all such customers. Let us then determine as closely as possible the average actual cost to the company of making and maintaining a connection to a residence, including interest and depreciation on that equipment used solely by one customer and not available for any other customer. Then let us include the cost of bookkeeping, meter reading, etc., and possibly including the cost of magnetizing current. Then let each customer's bill have printed on it this sum as a "connection charge," irrespective of whether any current be consumed inside the house or not. The usual "minimum charge" may be eliminated, the cost per kw.h. lowered a little, and the customer may buy, and pay for, as little as a single kw.h. or as much as he likes. With this system it really makes but little difference in the cost to the company per kw.h., whether the customer uses 10 or 100 kw.h. per month. Of course there must be a reduced price for large consumption, and to take care of this reduction the "block system" now in use in several places seems at least one of the best methods. With the block system each customer of a given class pays a given rate for the first block, a less rate for the second block, a still less rate for the third block,

and so on. The method is quickly understood by the public and is well liked where used.

For a householder whose use of electricity is not mainly for lighting, it now seems to be the general practice to install a second meter, and charge a different rate. Perhaps that is the most satisfactory thing to do at present.

It seems to the writer that the effort in apportioning charges among various classes of industrial consumers should be to make each class pay as nearly as possible the same rate of return to the company on such part of the company's plant and working staff as serves the particular class considered. Proper weight, however, must be given to the value of the service to the consumer, and to the price that the consumer can afford to pay. Certain classes of users may be able to pay more than other classes for a kw.h. consumption that may cost the company the same in either case. Such differences in value of service should be considered, as well as differences in cost to supply service. The writer also believes that generally speaking, too much attention is given to total consumption in kilowatt hours, and too little attention is given to load factor, and especially to the shape of the load curve, and that far too little attention is given to classes of load that may exist, or may be developed, and may be kept almost wholly off peak. It should be noted that a customer with an irregular load curve, but who is wholly off peak, will probably be more desirable, at least on an extensive system, than a customer with 100 per cent load factor.

The writer would favor the block system of charging in nearly all cases, and, where the size of the bill would justify it, would like to see a maximum-demand meter used. In that case a possible arrangement of blocks and of bills might be something as follows: (the figures are used for illustration only):

Form of Bill.

Consumption for month: K.W.H. Month of..

7320 KW. hours. Days, 30. Maximum demand 96. Product 2880

2880 KW..H @ 5c...	$144.00
2880 KW.H. @ 2½c....... .	72.00
1560 KW.H. @ 2c...............	31.20
7320 KW.H. for total sum of . .	$247.00

The preceding bill is for a customer having a monthly total load factor of a little under 10 per cent. For the same total consumption but a better load factor we may assume additional illustrative rates and construct a bill as follows:

Form of Bill.

Consumption for month: K.W.H. Month of. .

7320 KW. hours. Days, 30. Maximum demand 38. Product 1140.

1140 KW.H. @ 5c............................	$ 57.00
1140 KW.H. @ 2½c............................	28.50
1140 KW.H. @ 2c............................	22.80
1140 KW.H. @ 1¾c....................	19.95
1140 KW.H. @ 1½c............................	17.10
1140 KW.H. @ 1¼c..................	14.25
480 KW.H. @ 1c..............	4.80
7320 KW.H. for total sum of	$164.40

The preceding forms, of course, are simply equivalent to combining the block system with the method already used rather extensively of charging a rate depending upon the "hours use of maximum demand."

A rate-fixing commission should meddle as little as possible with such rate details as have been mentioned under the present heading, although a commission should be ready to advise upon such matters at the request of any company.

DISCUSSION—TURBINE AND BOILER EFFICIENCIES.

The papers of the evening were by R. F. Chevalier and Robert Sibley, on the subject of "Turbine and Boiler Efficiency Tests in Oakland," a copy of which appeared in the Journal of April 6, 1912.

At the conclusion of the delivery of the papers the following discussion was had:

Clem Copeland: The rating of these turbines were based on the 80 per cent power factor. Can anybody tell just why that is?

Robt. Sibley: The turbine at Station C in Oakland is rated at 15,000 kilovolt amperes. Therefore with an 80 per cent power factor, we considered it as a 12,000 kilowatt turbine.

Clem Copeland: I thought the rating was 15,000 kilovolt amperes and not 15,000 kilowatt capacity.

Robt. Sibley: The one in Oakland is 12,000 kilowatts; in San Francisco 15,000 kilowatt capacity at Station A.

C. E. Gaines: I would like to ask Mr. Sibley about the electrical measuring instruments, that is, what current and tension transformers did you use, and were these meters calibrated with these particular transformers before and after the test, and if there were any other instruments on the meter transformers during the test?

W. J. Davis Jr.: The measuring instruments were calibrated with their own particular transformers.

L. R. Jorgensen. Following the many interesting features of the installation shown in the pictures I have seen a detail which I do not quite understand. On the Parker boiler—which seems to be an excellent piece of apparatus—the manhole covers, or handhold covers, cannot be taken out except by breaking a tube. That seems to me not a good feature and could be remedied

R. F. Chevalier. There is a manhole in the front end of the drum, and this is of standard design and can be removed easily. The handhole covers have metal to metal seats and require no gaskets. The joint is made from the inside, so that advantage can be taken of the pressure coming against the plate and joint, thus taking the strain off of the bolt and spider. These plates are circular in design so as to facilitate grinding in event of scoring the seats and also to remove any rust that may accumulate during a cleaning period. Owing to this design it is necessary to make the plates smaller than the outside diameter of the tubes so as to enable placing them in each header before inserting the tubes.

L. R. Jorgensen: That is a bad feature about it

R. F. Chevalier: It is a bad feature if you have to remove the handhole plates, but as it has proven, it is rarely necessary to do so.

H. W. Crozier: I should like to ask Mr. Chevalier, is there anything gained, or any special reason why the circulation in the Parker boiler is down for the water as it is heating? As I understand, the water comes at the highest point, and the circulation is gradually down towards the hotter fire. That seems to be contrary to most of the laws of the circulation of water, and in most other types of boiler I believe the circulation is up as the water heats to allow the less condensed water to rise, and at the same time the temperature in the tubes is less. In this case the circulation is down, and you are therefore forcing the water against its natural direction of circulation. Is there any reason for that or explanation of that?

R. F. Chevalier: There is a reason. The inventor of the boiler, Mr. J. C. Parker, realized that if it were possible to design a steam generator so that the feed water entered that part where the gasses were coolest, then causing this water to flow down through the tubes so that the heating surfaces containing the hottest water and steam would be in contact with the hottest gases, the maximum transference would be realized. Such data as have been obtained show that this theory is evidently correct. It will be remembered that the escaping gases from the boiler during the efficiency test averaged 370

degrees F. The temperature of the saturated steam corresponding to the pressure was 382 degrees F. This condition could hardly exist—and besides would result in a loss of efficiency were it not for the fact that the feed water enters and flows through the tubes comprising the heating surface in the last pass of the boiler, and that the temperature of this water is much less than that of the steam. The temperature of the escaping gases in the capacity test averaged 440 degrees F.—the boiler was operating at 175 per cent of the builder's rating, evaporating 6.46 pounds of water from and at 212 degrees F per square foot of heating surface. I have searched over considerable reliable data on evaporative tests with oil fuel, and in no instances have I found records of such low temperatures of escaping gases when the boilers were operating at a corresponding rating.

Question: Have they found it necessary to put on those non-return valves?

R. F. Chevalier: The non return or check valves are necessary in order to force the circulation of the water downward, although there have been instances where the boiler was operated without any valves. Personally I know of an occasion where an engineer had removed the checks from two 150 h.p. boilers. These boilers operated a year without any checks, and the only difference that was noted was the increased amount of scale and dirt that was deposited in the tubes.

L. R. Jorgensen: It seems that the lower tubes must act like a superheater also.

R. F. Chevalier: No definite data, to my knowledge, has ever been secured whether or not the bottom tubes superheat the steam. If such is the case it would occur when the boiler is operating at a high rate of evaporation, and the superheat would disappear when the steam is discharged from the upcast tubes into the drum and comes in contact with the saturated steam and water from the other tubes. When a boiler is operating below the rating for which it was designed, there is evidently considerable water in the lower tubes. The proof of such being the case is that thin scale is found deposited in the lower rows. It would be an easy matter to attach a calorimeter to an upcast from the bottom tubes, and thus determine the proportion of steam and water discharged by these tubes providing not too great a quantity of water was entrained.

H. W. Crozier. I would like to ask a couple of questions about the cleaning of these boilers. I understand that in the same station, in addition to the Parker boilers there are boilers of other water tube types, which of course collect scale in the tubes. Now, does the Parker boiler collect scale at the same rate or the same amount of scale in the tubes as the others? If it does, how often is it cleaned? And the third question is about the caps, grinding them in. Will you give us some idea of how much time it takes and how much it costs to grind in a set of caps? One boiler is extensively advertised on account of the fact that it has no caps to grind in.

R. F. Chevalier: As yet the boilers at this plant have not been operated long enough to make any comparison between them as to the difference in the amount of scale or incrustation deposited in the inner surfaces. Scale and dirt accumulate in the tubes of this type of boiler less than in those of any other type, and owing to the rapid circulation of water within the lower elements, the tubes of these remain comparatively clean. Owing to this fact it is not necessary to clean the boiler as often as other types. Removing the mud and scale from the drum is sufficient cleaning to take care of most of the deposit from the feedwater for a considerable period of time. The boiler that was under test had been operating from six to eight weeks intermittently, and prior to the test some of the caps were removed from both the steaming and feed elements. It was found that the tubes of the latter had a slight deposit of soft slush about 1/16 of an inch in thickness. The tubes in the steaming element were perfectly clean and free from dirt, and appeared the same as the day that they were placed in the boiler. I have under my supervision two boilers of this type of about 200 h.p. each. These boilers furnish steam for a cannery, and the water is very bad for boiler use, depositing considerable scale. These boilers are operated throughout the canning season without being cleaned and are run very hard. At the end of the season when the boilers are opened quantities of scale and mud are taken from the drums. The tubes in the feed water element have from ½ to ¾ of an inch deposit. The tubes in the steaming element have some scale; but it stands to reason that if the lower tubes exposed to the fire were very dirty they would soon blister and burn out. I notice that different feed waters affect the location of deposits of scale. Some waters will deposit most of their scale forming matter in the first tubes of the feed element; others in the middle tubes of this element, and other waters in the last tubes. There is also always a deposit of scale and dirt in the drum. I have known instances where the scale and dirt were deposited in the first two or three upper tubes of the steaming elements, where the circulation is not as rapid as in the lower tubes, this occurring when the feed water is very bad. I have seen a boiler opened that had not been operated very hard and have found it dirty. The grinding in and setting of a handhole plate should not occupy more than two or three minutes by a skilled workman. The operation is very simple. The plate is so arranged that a special wrench is easily fitted so that a couple of twists is generally sufficient to make a tight joint.

H. W. Crozier: I mean the whole boiler?

R. F. Chevalier: I have no record of the time required to make up the joints on a whole boiler.

K. G. Dunn: I would like to ask Mr. Sibley what percentage of the available energy in the steam was converted into useful energy under actual operating conditions?

Robt. Sibley: On the 10,000 kw. load, 13.876 lb. of water were used per kw. hr. delivered at the generator terminals. This test was at 187.2 lb. abs. pressure and 150.65 degrees superheat. The steam was exhausted from the turbine blades into the condenser, maintaining a vacuum of 28.229 in.

I find in reference to chart No. 1 in Marks & Davis' Steam Tables that the total heat of steam at 187.2 lb. abs. and 150.65 degrees superheat is 1281 B.t.u. Assuming perfect adiabatic expansion through the turbine stages into the condenser, I find also from this chart, that the total heat of the steam entering the condenser at 28.22 in. vacuum or .87 lb. abs. pressure, is 910 B.t.u. Hence there are available under ideal conditions, a total of 371 B.t.u. of energy to perform useful work. Since 1 kw. hr. represents (2645 × 1.34) B.t.u. of energy I find the efficiency to be.

$$\text{efficiency} = \frac{2645 \times 1.34}{371 \times 13.876} = 68.9 \text{ per cent}$$

In actual practice this efficiency will of course be slightly less.

W. J. Davis, Jr.: This particular turbine utilizes about 68.5 per cent of the available energy in the steam according to the Rankine cycle.

K. G. Dunn: This efficiency should be given because operating conditions vary, and the different showings of pounds of steam per kilowatt hr. do not necessarily indicate the economy of the unit itself, because it might be under high vacuum, and another operating under less favorable conditions.

Robt. Sibley: I think the ratio should be given on a different basis, in other words, on a thermal basis. I find a great many turbines are now beginning to be sold under this new guaranteed condition.

W. J. Davis, Jr.: While it is of great interest to the designing engineer to know the Rankine efficiency of his turbine, it is of no particular practical interest to the operator, for the reason that different types of turbines have different operating characteristics. One type of turbine may operate well at high superheat and at low vacuum, whereas another type may not; and consequently if each type is placed on the same basis as

regards superheat, steam temperature and vacuum, full advantage is not taken of the peculiarities of each type in working through these wide temperature ranges.

K. G. Dunn: I would like to ask Mr. Davis what type of turbine operates best at low vacuum?

W. J. Davis, Jr.: The impulse type, for the reason that in this type it is possible to employ peripheral speeds more than fifty per cent greater than it is possible to use in the reaction type. The increased peripheral speeds permit larger diameters, and consequently a larger discharge cross-sectional area for the steam in the last stage. The increased discharge area of the buckets in the last stage will permit a greater number of expansions within the moving elements of the turbine, and hence a more effective utilization of the available energy in the steam at the higher vacuums.

K. G. Dunn: You would use a constant correction factor for all changes of vacuum?

W. J. Davis, Jr.: The correction factor for changing vacuum is approximately a constant between 25 inches and 29 inches for constant load conditions and for any particular design of turbine.

On the larger turbines the correction for a Curtis turbine at or near full rated output between the limits mentioned, is approximately one pound of steam per kilowatt hour for a variation of one inch in back pressure. At half load the correction is approximately equal to one and one-half pounds of steam per kilowatt hour for each inch of variation in vacuum.

K. G. Dunn: The point I make is that the only basis of comparison would be on the basis of percentage of the available energy that the machine absorbs. You don't always get the same operating conditions. There is no turbine but what would gain by higher vacuum, and also by higher superheat, but you can go so far with the superheats that your total saving on station economy would not be as good as it would be with a lower superheat. It is a nice argument from the standpoint of the salesman to get a high superheat, but you can get that so high that your saving on station economy would be less than with a lower superheat.

W. J. Davis, Jr.: That is very true, but we must look a little further. The greatest advantage in the way of economy obtainable from the steam turbine is its ability to work through a very large temperature range. The efficiency of a reciprocating steam engine of the best design is higher than that of a steam turbine for the range through which it works, that is to say, it is possible to get a Rankine efficiency as high as 72 per cent with a reciprocating engine, as against 68 or 69 per cent with the turbine, but when we install the steam engine and the turbine so as to permit each to work under its own best conditions, the turbine will do better because it takes advantage of available energy which the reciprocating engine cannot reach. The best type of reciprocating engine cannot use the available energy in the steam where the vacuum exceeds 23 or 24 inches.

K. G. Dunn: I think you will find that the majority of steam engines do about twenty expansions. The highest economy of course would be in using steam through an engine down to approximately atmospheric pressure, which would be better than a turbine, and then using an exhaust turbine. When you stop to consider the investment charges and the maintenance charges that hardly works out so well. What I mean is this, in regard to the superheat only, what is the use of a turbine which will show a very low water rate on an excessively high superheat, if a station economy of a still lower water rate could be obtained by a lower degree of superheat? That is the point I am trying to make—the cost per kilowatt on the switchboard gauge—not at generator terminals.

W. J. Davis, Jr.: In stations operating at 180 pounds gauge steam pressure, the use of 100 degrees F. superheat would be attended by an increase of approximately 4½ per cent in the fuel consumption. Steam so superheated will decrease the water rate on most Curtis turbines about eight per cent, from which it will be seen that there is a net gain of three and one-half per cent due to the use of 100 degrees superheat. The net economy to be obtained from a superheat of 150 degrees is bound to be approximately five per cent; and for this reason the present tendency in the larger and more modern power stations where load conditions are favorable is towards the increase of higher superheats. The Boston Edison Company and the Commonwealth Edison Company of Chicago are now working at 150 degrees F. superheat. While superheats exceeding 200 degrees are not unusual abroad, the tendency in the States is towards more conservative practice, due to the increased cost of installation and maintenance of steam piping, valves and so forth, required for the higher temperatures.

H. W. Crozier: What about your auxiliaries at these high superheats? Aren't you getting into packing troubles and other things which would be avoided by using somewhat less?

W. J. Davis, Jr.: Yes. All valves and fittings are more expensive, and require increased maintenance cost.

H. W. Crozier: Isn't it good practice to carry moderate superheat on account of the effect on the auxiliaries, that is, the cost of the packing and repairs that you have to do to the auxiliaries?

W. J. Davis, Jr.: Yes. Where under steady load conditions on the station a higher superheat may be carried than where the load is variable.

H. W. Crozier: I want to ask Mr. Chevalier a question about the steam performance of the boiler. Did that include the steam used by the burner?

R. F. Chevalier: In calculating the efficiency the steam used by the burner was not deducted from the total evaporation of the boiler, for this is a matter which concerns the fuel, type of burner and furnace, and should not be charged against the boiler when making a comparison on the performance.

H. W. Crozier: You consider that the steam used by the burner is a matter in regard to the fuel, and nothing whatever to do with the boiler?

R. F. Chevalier: If no steam were used for atomizing the weight of the escaping gases would be reduced, and there would consequently be less heat lost thereby. In this way there may be a very small gain by the boiler as a unit. However, commercially the net output of the boiler is what counts, and the amount of steam used to prepare any fuel for burning should be taken into consideration. With oil fuel the amount of steam required for atomization is quite an item of cost and varies with the type of burner, furnace arrangement and draft. I have data at hand on the amount of steam used by the burners on the efficiency test if you care to hear it.

H. W. Crozier: I would be very much interested.

R. F. Chevalier: The total steam used by the burners for eight hours was 5520 pounds. The total water actually evaporated was 205,277 pounds.

The total equivalent evaporation was 241,611 pounds.

$\frac{5520}{205277}$ equals 2.7 per cent of the total water evaporated.

$\frac{5520}{241611}$ equals 2.29 per cent of the equivalent evaporation.

$\frac{5520}{14979}$ equals .369 lb. of steam required to atomize 1 lb. of oil.

C. F. Braun: Returning to the question which was asked the author of the paper as to what advantages were derived by causing the water to circulate in a downward direction through the tubes, there is one point which was not touched upon and which is perhaps worthy of mention.

It is a generally accepted fact that the rate of transmission of heat between steam, gases or liquids through metal division

is proportional to the difference in temperature between the substances on each side of the hot surface. However, in a boiler the temperature of the substances themselves is not the same at all parts of the hot surfaces, for the temperature of the gases decreases in their course and the temperature of the water increases. Only one temperature value can be used in canculation, and that is the mean. For any given set, initial and final temperatures of the gases and of the water, the mean temperature difference will be greater if the heating gases and the water to be heated have opposite directions of flow. By constraining the water to flow downward while the gases travel upward this ideal condition of opposite flow is approached. The equation for mean temperature difference is

$$D \text{ mean} = \frac{d_1 - d_2}{\log_e \dfrac{d_1}{d_2}} \quad \text{where}$$

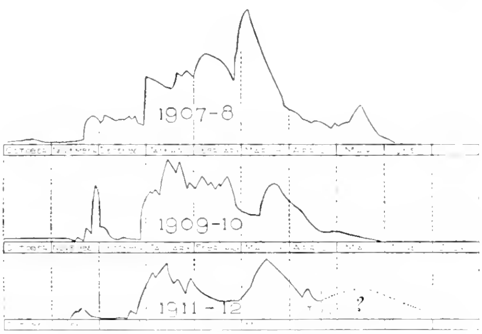
d_1 = the temperature difference between gases and water at commencement;

d_2 = the temperature difference between gases and water at the end.

By substituting any set of assumed values it will be readily seen that the mean difference is greater with counter flow, and it follows that the heat transmission per square foot of boiler surface is greatest.

THE PRESENT DEPTHS OF SNOW AT MOUNTAIN SUMMITS.

Much agitation has been felt among engineers of the Pacific Coast regarding the lack of snow in the Sierras, Cascades and Rockies for the present season.



Snow Depths at Summit Showing Present Depth Greater Than Any of the Three Lean Years Given

Professor Alexander McAdie of the U. S. Weather Service has compiled the charts shown herewith, which definitely compare the present year with two other recent "lean" years. From this and other data in the office of the Weather Service the following snow-depths for various years have been ascertained:

Depth of Snow at Summit.

	1907	1908	1909	1910	1911	1912
April 1	240	50	188	65	135	50 inches
May 1	115	20	119	13	94	"
June 1	68	13	27	2	38	"

From this it is seen that no serious alarm may be felt over hydroelectric storage for the present season. In fact the snow depth now at Summit is as good if not better than the seasons of 1908 and 1910.

A NEW WATER CODE FOR WASHINGTON.

Washington will have the most practical advanced code of water rights and uses in the Union if the measure, to be submitted by a committee of 15 appointed by Governor Marion E. Hay at a conference in Spokane, April 18, is enacted by the state legislature at Olympia, next January. The plan is to harmonize the most beneficial features of the best codes of the various states, adapted to Washington, and formulate uniform laws that will have the effect of promoting development of all projects for the use of water and encourage capital and settlers.

Governor Hay, who was the first speaker at a meeting of irrigationists, water users and representatives of power development companies in the rooms of the Spokane Chamber of Commerce, where all parts of the state were represented, said he fully realized the importance of a practical water code, saying also that the present laws governing the water proposition in Washington are conflicting and utterly inadequate for either irrigation or power.

This committee was appointed on recommendation of E. F. Benson of Prosser and A. J. Ternant of Quincy:

Lachlan MacLean, Spokane; E. C. Burlingame, Walla Walla; William T. Clark, Wenatchee, and Arthur J. Shaw, Spokane, representing the water users; Prof. O. L. Waller, Pullman; C. H. Swagart, North Yakima, federal reclamation engineer in charge of the State of Washington; Joseph Jacobs, Seattle, engineer in charge of the Quincy Valley project; Marion Chase, Okanogan, irrigation engineer; Carroll B. Graves, Seattle; Ira P. Englehart, North Yakima; Ralph P. Williamson, North Yakima; Cyrus Happy, Spokane; Eugene W. Burr, North Yakima, attorney of the United States Reclamation Service, and L. K. Armstrong, Spokane, representing the irrigationists and David L. Huntington, president of the Washington Water Power Company, Spokane, representing the power companies.

The committee will meet several times during the year at Wenatchee, North Yakima, Spokane and other points in the irrigated belts. The idea is that if the proposed code meets with the approval of these centers of irrigation, when presented for passage by the legislature at its next session, it would have the support of the entire state, thus insuring its passage.

Professor Waller, who is thoroughly familiar with every phase of irrigation in the State of Washington and throughout the Northwest, said an owner of irrigated land in Washington cannot abstract a water title at present, adding that this bars the investment of capital in such enterprises and retards the development and settlement of the lands.

Others taking part in the discussion were: Eugene W. Burr of the reclamation service at North Yakima, H. R. Mann of the Loon Lake Irrigation Company, Stephen O. Jayne, Spokane, irrigation expert in Washington for the Department of Agriculture; Arthur J. Shaw, representing the D. C. Corbin irrigation interests in the Spokane Valley and William T. Clark, Wenatchee. Lachlan MacLean presided at the conference, the secretary being A. J. Ternant.

WESTERN LAWS OF ELECTRICITY AND WATER

LOSS OF WATER RIGHTS.

BY A. E. CHANDLER.

Water rights, like other real property, may be lost by abandonment, forfeiture, adverse user or prescription or estoppel.

Abandonment and Forfeiture.

Abandonment is often defined as "the relinquishment or surrender of rights or property by one person to another," but in the law of waters abandonment simply adds to the unappropriated public waters and the benefits therefrom are not intended to accrue to a particular person. It consists of the two elements, act and intention; although the latter is generally considered the "essence" thereof. As stated in Utt v. Frey (106 Cal. 397):

> The mere intention to abandon, if not coupled with yielding up possession or a cessation of user, is not sufficient; nor will the nonuser alone without an intention to abandon be held to amount to an abandonment. Abandonment is a question of fact to be determined by a jury or the court sitting as such.

The intention to abandon must be shown by nonuse and similar acts, but nonuse, unless continued for an unreasonable period, will not be sufficient. The presumption created by even an unreasonable non-use may be overcome by satisfactory proofs. The opinion of the Supreme Court of Montana in Smith v. Hope Mining Company (45 Pac. 632) is especially noteworthy as the water to run a mill had not been used for nine years but the machinery was cared for and maintained in good condition during the period of non-use. The Court said:

> It is true that the evidence shows without controversy that the Algonquin Company did not use the waters, in their mill or otherwise, for a period of about nine years following 1883. But mere nonuser of a water right is not abandonment. The nonuser of water for so long a period, and especially a period longer than the statute of limitations, is certainly competent evidence, if it stood alone, of an intention to abandon. * * * But what ever force the fact of nonuser for nine years may have had in showing an intention to abandon, that force was wholly offset and contradicted by the other evidence in the case, so as to leave, in our opinion, not even a conflict of testimony.

As riparian rights to the use of water do not depend upon use nor cease with disuse, they cannot be lost by abandonment, so that this question can only be raised regarding rights by appropriation. Although water rights and ditches are generally thought of as one, they are distinct property interests and either may be held without the other. A ditch can accordingly be abandoned without abandoning the water right. Likewise water may be turned into natural water courses for diversion at lower points without it being held an abandonment—that is, the waterway may be used as part of the ditch system. It is also held without exception that the point of diversion, the place of use and the manner of use may be changed without loss of right, provided no other user is injured thereby.

As non-use under the court rulings simply raises the presumption of abandonment, a number of the western states have fixed by statute a definite period for which non-use will work a forfeiture of the right. The prescribed period in Utah is seven years; in Wyoming and Idaho five years; in New Mexico four years; in North Dakota and South Dakota three years; in Oklahoma two years; in Oregon one year. Both the Utah and Oregon statutes contain the added provision that a question of abandonment shall be one of fact, to be tried and determined as other questions of fact. The virtue of the two statutes is thereby destroyed as the aim of such statutes is to definitely fix the period of non-use which shall constitute a forfeiture and thus preclude court proceedings to determine the intention. The Supreme Court of Oregon in Hough v. Porter (98 Pac. 1083) recently said:

> The right to the use of water by nonuser alone cannot be deemed forfeited short of the period prescribed by the statute of limitation for real actions. Dodge v. Marden, 7 Or. 456. But such right may become extinguished by any act showing an intent to surrender or abandon the right, after which, if the person having the right ceases its use for one year, his interest is lost; but the facts essential to a forfeiture by this company are not established by the proof. The nonuse from 1893 to 1900 is shown; but this alone is insufficient. To constitute an abandonment of a water right, there must be a concurrence of the intention to abandon it and an actual failure in its use.

The leading California case on the question of forfeiture, or loss of right through non-use, and one much quoted in other jurisdictions, is Smith v. Hawkins (110 Cal. 122). The court therein distinguishes between abandonment and forfeiture, and on account of its importance the following long quotation is given:

> Section 1411 of the Civil Code declares that the appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such purpose, the right ceases. This section deals with the forfeiture of a right by nonuser alone. We say nonuser, as distinguished from abandonment. If an appropriator has, in fact, abandoned his right, it would matter not for how long a time he had ceased to use the water, for the moment that the abandonment itself was complete his rights would cease and determine. Upon the other hand, he may have leased his property, and paid taxes thereon, thus negativing the idea of abandonment, as in this case, and yet may have failed for many years to make any beneficial use of the water he has appropriated. The question presented, therefore, is not one of abandonment, but one of nonuser merely, and, as such, involves a construction of Section 1411 of the Civil Code. That section, as has been said, makes a cessation of use by the appropriator work a forfeiture of his right, and the question for determination is, How long must this nonuser continue before the right lapses?
>
> Upon this point the legislature has made no specific declaration, but, by analogy, we hold that a continuous nonuser for five years will forfeit the right. The right to use the water ceasing at that time, the rights of way for ditches and the like, which are incidental to the primary right of use, would fall also, and the servient tenement would be thus relieved from the servitude.
>
> In this state five years is the period fixed by law for the ripening of an adverse possession into a prescriptive title. Five years is also the period declared by law after which a prescriptive

right depending upon enjoyment is lost for nonuser; and for analogous reasons we consider it to be a just and proper measure of time for the forfeiture of an appropriator's rights for a failure to use the water for a beneficial purpose.

In the preceding article it was stated that under the doctrine of prior appropriation one is given a reasonable time after the completion of the diversion works in which to apply the water claimed to beneficial use. In the case of an irrigation project this application requires a number of years which is definitely fixed in those states where appropriations are made by application to the State Engineer, but which, in states like California where the posting of notices is still tolerated, is limited only by the rule of reasonable diligence. This time limit for the larger projects has seldom been passed upon in the reported cases. The five-year period fixed in Smith v. Hawkins must not be taken as a precedent in cases of incomplete appropriations as in the latter the right to the full amount of the appropriation is conditioned upon the irrigation of all the land under the ditch within a reasonable time. Smith v. Hawkins deals with a right which had become completely vested and later fell into disuse. It is believed that the larger irrigation projects will be allowed a longer period than five years in which to apply all the water to beneficial use as the settlement of such generally necessitates a greater time.

Adverse Use of Prescription.

These are a very few cases involving the alleged wrongful divrsion of water in which a right by adverse use or prescription is not pleaded. Nevertheless there are very few cases in which such title is upheld, as it is seldom that a case presents all the elements necessary to prove adverse use. In order to ripen into title the adverse use must be continuous for the statutory period, open, notorious, peaceable, under claim or color of right, and to the damage of the water-user against whom the right accrues. The burden of proof is on the claimant of the adverse title.

The statutory period referred to is the period provided in the statute of limitations regarding actions pertaining to real property. The period for the western states is as follows: Arizona, three years; California, Colorado, Idaho and Nevada, five years; Utah, seven years; Montana, Nebraska, North Dakota, Oregon, Texas, Washington and Wyoming, ten years; Kansas, fifteen years; South Dakota, twenty years. By "continuous" is not meant that the use should be unceasing for the period, but simply that the claimant used the water during such times as he needed it. In the case of irrigation the water might be needed but one day during each month of the irrigation season, and such use if made for the statutory period would be held "continuous."

"Open" and "notorious" signify that the use has not been by stealth but on the contrary "before all the world," so as to be generally known. "Peaceable" (or "interrupted") means that the original possessor of the right has not intertered with the adverse use. Any interference or interruption, however, slight, will prevent the acquisition of the right. Mere verbal protests, however, are not considered interruptions—the latter must be due to some physical act, such as closing down a headgate, cutting a ditch bank, or breaking a diversion dam.

The claimant must consider and treat the right as his own and not acknowledge a superior claim on the part of the original owner. If at any time during the statutory period permission to divert the water has been sought, the adverse claim must fail.

That the use has been to the damage or detriment of the original possessor is generally the most difficult of the many points to prove. So long as there is sufficient water in the stream for both no such damage can result. This point is especially difficult when the adverse use is being claimed against a lower riparian owner. As such an owner does not have to use the water, no one knows what stream depletion —short of the diversion of the entire flow—will be of detriment. The problem was quite the other way in the early California cases where the riparian owner sought to enjoin an upper appropriator. In Heilbron v. Fowler Switch Canal Co. (75 Cal. 426) the company, an appropriator, claimed that its diversion would result in no appreciable injury to the plaintiff's land—a Spanish grant. Although the following quotation does not present other and very material facts upon which the court based its injunction, it shows the "one-sidedness" of the struggle between riparian owners and appropriators:

> The injury is one, also, which in its nature cannot be estimated. In the recent case of Heilbron v. Last Chance Company it was said: "The flow of the water of a stream, whether it overflow the banks or not, naturally irrigates and moistens the ground to a great and unknown extent, and thus stimulates vegetation, and the growth and decay of vegetation add, not only to the fertility, but to the substance and quantity of the soil."
>
> If this be so,—and it cannot be doubted—it is obvious that in a climate like that where this land is situated, the benefit derived from a flow of water for thirty miles along its boundary, and ten miles through it, cannot be inconsiderable, but yet the extent of benefit must ever be an unknown quantity.
>
> The defendant here states that the channel of the river above and along this land is deep, and therefore at times of ordinary flow the seepage cannot be great. If so, it must be important to plaintiffs that the channel should carry a full stream, and evidently at such times the percolation would be increased.

It is clear from the above that, unless the attitude of the court be changed, the riparian owner can easily show sufficient damage to secure an injunction, but the problem before the appropriator of showing sufficient damage to justify a finding of adverse use is far different. As stated the only case which is certain is where the appropriator has continuously diverted the entire low water flow. Regarding the damage as between appropriators Judge Hawley in Union Mill & Mining Company v. Dangberg (81 Fed. 73) said, "There must have been such a use of the water, and such damage, as would raise a persumption that complainant would not have submitted to it unless the respondents had acquired the right to use it."

The idea is current in California that use by an appropriator for the statutory period—five years—gives an absolute right as against lower riparian owners. As indicated above, the water must not only be used but it must be used adversely, so that the current view is far from correct.

It should be apparent to all that an appropriator can secure no adverse title against an upper riparian

owner, but cases are constantly arising where this plea is made. In Rogers v. Overacker (4 Cal. App. 333) the California Supreme Court in dealing with such a plea said:

The rule seems to be as laid down in Bathgate v. Irvine, 126 Cal. 135, 77 Am. St. ep. 158, 58 Pac. 442, and Hargrave v. Cook, 108 Cal. 72, 41 Pac. 18, 30 L. R. A. 390. In the first case it was said, approving the latter case, that a lower riparian owner cannot acquire a right, either by prior appropriation or by prescription or adverse user, as against an upper riparian proprietor whose rights antedate the appropriation and user, and the mere nonuser of the water by the upper proprietor and his permitting the water to pass down to the lands of the lower owner can not make the user of the lower owner adverse or strengthen his claim of appropriation or prescription.

The expression "as against an upper riparian proprietor whose rights antedate the appropriation and user" refer to the well settled rule that the rights of the appropriator are superior to those of the riparian owner where the former had initiated his appropriation while the riparian land in question was unentered public land. Occasionally, even in the reported cases the rights of the appropriator are considered superior if initiated before patent issued for the riparian land. The present accepted view is, however, that the riparian owner's rights date from his entry of the land and not from the issuance of patent, and, therefore, to be superior, the appropriator must have initiated his rights to the land.

Estoppel.

"Estoppel by silence" arises where a person who by force of circumstances is under a duty to another to speak refrains from doing so and thereby leads the other to believe in the existence of a state of facts in reliance upon which he acts to his prejudice (16 Cyc. 681).

Although the general principles of appropriation are understood by those diverting, or intending to divert, water and especially the rule that the subsequent appropriator takes only what is left, it is very common to have the claim made that no notice of the rights of the opposing party was given and that said party is estopped from setting up a superior right. The courts very early in the mining period expressed themselves strongly to the contrary but the claim still persists. In a recent California case dealing with underground waters it is said:

The mere fact that the defendants expended money in sinking the wells and putting in the pumps each upon his own land, with the knowledge of the plaintiffs and without objection by them, creates no estoppel. A mere passive acquiescence when one is under no duty to speak does not raise an estoppel." (Verdugo Canyon Water Company v. Verdugo 152 Cal. 655).

Practically the same language has been used in a number of cases where the point was raised. It is therefore established beyond doubt that neither a riparian owner nor an appropriator need serve notice of existing rights upon a subsequent appropriator engaged in the construction of diversion or storage works.

Rights of Way by Prescription.

Rights of way for ditches may be acquired by prescription in the same way as water rights. The most serious element in so proving is the "color of title." After a ditch has been constructed and operated for years it is very difficult to show that the right does not rest upon permission to occupy given by the owner of the land crossed—that is, parol license. The statute of frauds provides that interest in real property can be conveyed only by written instruments. As a ditch right of way is such an interest, the original and strict legal rule is that the right cannot be founded on a parol license; but the rule has been modified, if not reversed, in a great many of the states.

In the very recent case of Gustin v. Harting (121 Pac. 522), decided Feb. 17, 1912, the Supreme Court of Wyoming considered at great length the question as to whether the plaintiff had acquired a right of way for a flume by prescription and also the right to maintain it under an irrevocable license—it being admitted that the flume had been constructed with the parol consent of the landowner, the defendant. It was held that, under the existing facts, the license was irrevocable and the right to maintain the flume secured by prescription. In reaching its conclusion the Court said:

The principle that a parol license, when executed by the expenditure of money or labor, if not given for a mere temporary purpose, becomes irrevocable, has been recognized and applied in several other cases involving irrigating works.

Among the many cases cited and examined in support of the principle are some from California Colorado, Nebraska and Oregon, showing that they also recognize the modified rule. To these Utah may be added.

The Supreme Courts of Montana and Washington refuse to accept the modified rule. In Archer v. Chicago M. & St. P. Ry. Co. (108 Pac. 571), decided April 2, 1910, the Supreme Court of Montana considered cases in favor of the new rule but held that, "sound * * * reasoning sustains the rule that a parol license of the character of the one under consideration is always revocable at the pleasure of the licensor."

ELECTROLYTIC SEWAGE TREATMENT

The electrolytic process for deodorizing sewage and destroying the disease germs which flourish in it has been adopted by the municipality of Santa Monica, Cal., and is reported to have proven a success, this enterprising city having ordered a second plant after a six months' test.

The plant was installed at Santa Monica in 1908 at a cost of $10,0000 and treats 550,000 gallons every twenty-four hours. The total cost of operation is $400 a month, but the greater part of this is for pumping, which is made necessary in this case by the lay of the land, and for the services of two men to care for the pumping outfit.

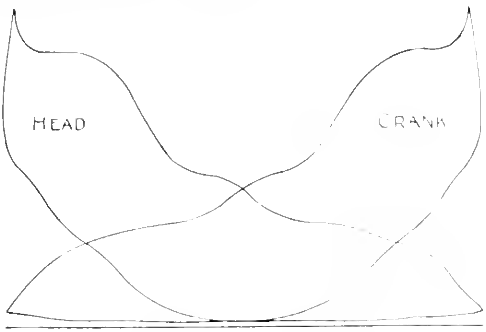
The plant is installed under the street at the shore end of the municipal pleasure pier, and its efficiency in removing all trace of odor from the sewage is indicated by the fact that no complaint is made by the thousands of people who frequent the pier or by the business men and residents in the vicinity, although the sewage is constantly flowing through the open troughs in the room under the street and thence discharging into the Pacific at the outer end of the pier, 1600 feet from the shore.

SOLUTIONS OF THERMOTWISTERS.

WATER CONSUMPTION FROM INDICATOR CARD—NINETEENTH LECTURE.

BY W. S. HEGER AND ROBERT REID.

1. The indicator card given below is that of a simple engine of 12 in. stroke, 12 in. piston diameter, 1⅛ in. piston rod diameter and 235 r.p.m. The scale of the highest pressure shown on the card is 80 lb. gauge. What is the indicated water consumption per hour, without making allowance for the piston rod diameter?



Water Consumption from Indicator Card

For the purpose of solution, the clearance was assumed to be 10 per cent of the stroke at each end.

The best place to make the above determination is at about 2/3 of the stroke, therefore p is drawn there and the following are scaled from the card:

$p = 40.4$ lb. abs. $\quad b = 7.94$ in.
$P_b = 16.3$ lb, abs. $\quad x = 5.35$ in.

From the steam tables,

$w = .09463$ lb. per cu. ft
$w_1 = .04129$ lb per cu. ft.

Clearance $c = 1.2$ in.

$W = 60\,N\,a\,[w\,(c + b) - w_1\,(c + x)]$
$W =$ Weight of water per hour
$N = 2 \times$ r.p.m.
$a =$ Area of piston in sq ft.

$$W = 60 \times 2 \times 235 \times .7854 \left[.09463 \frac{(1.22 + 7.94)}{12} - .04129 \frac{(1.2 + 5.35)}{12} \right]$$

∴ $W = 1095$ lb. per hour.

In finding the indicated horsepower it is first necessary to find the mean effective pressure and this can be done most accurately in this case (since the area is very irregular) by using Simpson's Rule to get the area:

$A = h/3\ (A + 4\ B + 2\ C)$

Where

$A =$ Sum of 1st and tenth ordinates.
$C =$ Sum of other odd ordinates
$B =$ Sum of even ordinates.

By dividing the card into 10 equal parts gives:

$$A_h = \frac{1.2}{3} (885) = 354 \text{ sq. in.}$$

M.E.P. = area / total length of card

$$\frac{354}{12} = 29.5 \text{ in}$$

$$A = \frac{1.2}{3} (885.9) = 354.5 \text{ in.}$$

Av. M.E.P. = 29.51 lb.

$$\text{H.P.} = \frac{\text{PLAN}}{33000} = \frac{29.51 \times 1 \times 144 \times .7854 \times 235 \times 2}{33000} = 47.4 \text{ h.p.}$$

$$\text{Water consumption / I.H.P. Hr.} = \frac{1095}{47.4} = 23.12 \text{ lb.}$$

2. Compute the indicated water consumption per hour, making full allowance for piston rod displacement.

Head End Computation.

Area of piston $= a = .7854$ sq. ft.
$P = 38.2$ lb. abs.
$W_p =$ weight of steam per cu. ft. at 38.2 lb. $= .0913$ lb.
$P_b =$ back pressure $= 16.52$ lb. abs.
$W_b =$ wt. of steam at 16.52 lb. $= .04167$ lb.
$c =$ clearance $= 0.1$ ft.
$b =$ dist. of P from beginning of stroke $= .581$ ft.
$N =$ No. of strokes per min. $= 235$.
$W =$ indicated water consumption per hour.
$x =$ dist. the pt. of comp. from beg. of for. stroke $= .3$ ft.
$W_h = 60\,N\,[W_p a\,(c + b) - W_b a\,(c + x)]$
$W_h = 60(235)\,[(.0913)(.7854)(.681 - (.4167)(.7854)(.4)]$
$W_h = 14100\,(.0488 - .0131) = (14100)\ (.0357)$
∴ $W_h =$ **503 lb. water per hour (Head End).**

Crank End Computation.

Area piston rod $= .00694$ sq. ft.
∴ A (crank end) $= .7785$ sq. ft. $\quad x = .404$ ft.
Other values the same as for Head End.
$W_c = 60\,(235)\,[(.0913)(.7785)(.681) - (.04167)(.7785)(.504)]$
$W_c = (14100)\ (.0484 - .0163) = (14100)\ (.0321)$
∴ $W_c =$ **452 lb. water per hour (Crank End).**
Total consumption per hour = 958 lb.

Steam Turbine Efficiencies—Twenty-first Lecture.

BY H. E. SANDOVAL AND U. S. ATTIX.

1. (a) A steam turbine operates under 200 lb. absolute pressure and ½ lb. abs. vacuum. Compute the Rankine and Carnot efficiencies, the entering steam being dry.

Formula:

$$\text{Rankine efficiency} = \frac{H_1 - H_2 + (n_2 - n_1)\,T_2}{H_1 - h_2}$$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1}$$

H = total heat.
h = heat of liquid.
n = entropy
T = absolute temperature.

Computations:

Data from Marks & Davis' Steam Tables.

$p_1 = 200$ lb. $\quad T_1 = 381.9 + 459.6 = 841.5$ degrees.
$H_1 = 1198.1 \quad n_1 = 1.5456$
$p_2 = .5$ lb. $\quad T_2 = 79.68 + 459.6 = 539.3$ degrees.
$H_2 = 1094.6 \quad n_2 = 2.0339 \quad h_2 = 47.7$

$$\text{Carnot efficiency} = \frac{841.5 - 539.3}{841.5} = \frac{302.2}{841.5}$$

35.9 per cent.

Rankine efficiency

$$= \frac{1198.1 - 1094.6 + (2.0339 - 1.5456)\,539.3}{1198.1 - 47.73}$$

$$\frac{103.5 + .4883\,(539.3)}{1150.40} = \frac{367.3}{1150.4}$$

31.9 per cent.

(b) entering steam has 10 per cent moisture.

BY GEO. M. SIMONSON AND D. L. BABCOCK.

Solution

From Marks & Davis' Steam Tables using their notation, we have:

$p_1 = 200$ lb. abs.	$p_2 = 0.50$
$h_1 = 354.9$	$n_2 = 48.03$
$L_1 = 843.2$	$L_2 = 1046.7$
$H_1 = 1198.1$	$H_2 = 1094.8$
$n_1 = 1.5456$	$n_2 = 2.0330$
$T_1 = 381.9 + 459.6$	$T_2 = 80.0 + 459.6$
$= 841.5$ degrees abs.	$= 539.6$ degrees abs.
$x = 90$ per cent.	

Computations for Rankine efficiency.

$$\text{Useful energy, } E = H_1 - H_2 + (n_2 - n_1)\,T_2 - \frac{L_1}{T_1}(1 - x_1)$$

$$(T_1 - T_2) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$E = 1198.1 - 1094.8 + (2.0330 - 1.5466)\ 539.6 - \frac{843.2}{841.5}$$

$$(1 - .90)\ (841.5 - 539.6)$$

$E = 103.3 + 263.0 - 30.25$
$E = 336.05$ B.t.u.

$$\text{Total heat supplied} = h_1 + x_1 L_1 - h_2$$
$$= 354.9 - .90 \times 843.2 - 48.03$$
$$= 1065.75 \text{ B.t.u. supplied.}$$

$$\text{Rankine efficiency} = \frac{336.05}{1065.75} = 31.53 \text{ per cent}$$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1}$$

$$= \frac{841.5 - 539.6}{841.5} = \frac{301.9}{841.5} = 35.88 \text{ per cent.}$$

Turbine Losses and Their Study—Twenty-Second Lecture.

BY A. F. BRIDGE.

Steam is delivered to a turbine at 180 lb. abs. and 100 degrees superheat. The condenser pressure is 0.5 lb. abs. Determine the energy in each pound of steam leaving the nozzle, assnming a loss of 10 per cent in the nozzle due to friction.

Consulting the Heat-Entropy Diagram which accompanies the Marks and Davis tables we obtain the following data steam under the conditions given above (180 lb. and 100 degrees superheat) has a total heat content of 1254 B.t.u. Since the entropy is constant we follow the vertical line to its intersection with the 0.5 lb. pressure line, obtaining 874 B.t.u. as the total heat in the steam at exhaust. The heat drop is then $= 1254 - 874 = 380$ B.t.u. In the absence of such data, it is assumed that this is a single stage turbine of the pure impulse type. Since only 90 per cent of the original energy of the steam is available at exit from the nozzle due to friction loss therein we have energy per lb. at point of leaving nozzle $= 380 \times 0.9 = 342.0$ B.t.u., or converting into mechanical units $= 342 \times 778 = 266070$ ft. lb. of steam.

Under the conditions of the problem the total energy in the steam issuing from the nozzle is therefore 266,076 ft. lb. of steam.

2. The nozzle makes an angle of 20 degrees with the moving blades in the above turbine and the steam leaves at a relative angle of 30 degrees. Assuming five stages of expansion and that the blades move with a velocity of 500 ft. per sec., what is the steam to bucket efficiency?

BY H. T. CARLTON.

From Molier diagram as given in steam tables of Marks and Davis.

Quality of steam = 78.8 per cent.
Total heat (180 lb. and 100 degrees superheat) = 1255 B.t.u.
Total heat (.5 lb. abs.) = 870 B.t.u.

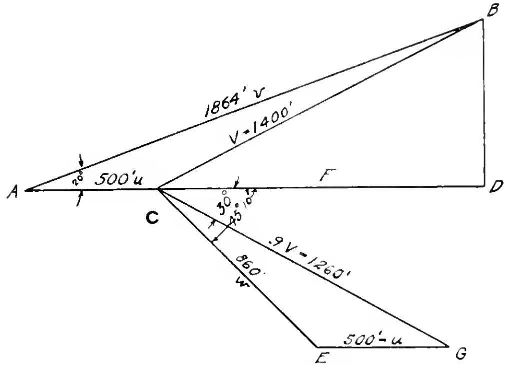
Heat drop = 385 B.t.u.

$$\frac{385}{5} = 77 \text{ B.t.u. drop per stage.}$$

Entering velocity $V = 212.42 \sqrt{77} = 1864$ sec. ft

In the following it is assumed for simplicity that there is only one rotating blade per stage. The steam to bucket efficiency of the first stage is there computed as follows:

In the figure, AC is laid off to scale equal to 500 ft., which is the velocity of the rotating blade. AB is next laid off equal to the velocity of the impinging steam from the nozzles, which makes an angle of 20 degrees with AC as shown. Completing the vector diagram, BC is found to scale 1400 ft., which is the velocity of the steam along the surface of the rotating buckets. This velocity gradually diminishes due to friction and leaves the rotating vane usually in magnitude equal to 9/10 of V or in this case 1260 ft. per sec., forming an angle of 30 degrees as given in the problem. Completing a vector diagram, we find CE measures 860 ft. per sec., making an angle of 15 deg. 10 min. with AC. The entering steam, then, forces the wheel ahead by the component



Turbine Velocity Diagram

$$A\,D = A\,B \cos 20°$$

And as the steam leaves a backward reaction is felt in amount of

$$C\,F = C\,E \cos 45° \; 10'$$

Each pound of entering steam possesses an inherent energy of $778 \times 32.2\,(H_1 - H_2)$ ft. lb. and this gives up energy to the rotating buckets of $u\,(v \cos_\alpha + {}_\omega \cos \beta)$ ft. lb

$$\therefore \text{efficiency} = \frac{u\,(v \cos_\alpha + {}_\omega \cos \beta)}{778 \times 32.2\,(H_1 - H_2)}$$

$$= \frac{500\,(1864 \cos 30 + 860 \cos 15 \; 10')}{778 \times 32.2 \times 77}$$

$$= \frac{500\,(1864 \times .940 + 860 \times .706)}{778 \times 32.2 \times 77} = \frac{1{,}179{,}000}{1{,}929{,}000} = 61.1\%$$

3. What should gauges read, if inserted at each of the above stages of expansions?

BY DAVID L. CLEMENT AND W. S. VAN WINKLE.

In solving this problem the Mollier diagram, as given in Steam Tables of Marks & Davis, was used to determine the total heat in the steam at the initial and final conditions.

At 180 lb. per sq. in. abs. Bt.u. value = 1251.3
At 0.5 lb. per sq. in. abs., B.t.u. value = 873.0

Total heat drop .... 381.3 B.t.u.

Assuming that the heat drop is equal in each stage, which is very nearly so, we have a drop of $381.3 \div 5 = 76.26$ B.t.u. per stage.

The B.t.u. value at the entrance to each stage is now determined.

1st stage,	1254.3	B.t.u.
2d stage,	1254.3 — 76.26 = 1178.04	B.t.u.
3d stage,	1178.04 — 76.26 = 1101.78	B.t.u.
4th stage,	1101.78 — 76.26 = 1025.52	B.t.u.
5th stage,	1025.52 — 76.26 = 949.26	B.t.u.

Reading on the constant entropy line of the Mollier diagram we find the pressures corresponding to the B.t.u. values given above.

1st stage,	180 lb. per sq. in.
2d stage,	76 lb. per sq. in.
3d stage,	27 lb. per sq. in.
4th stage,	8.8 lb. per sq. in.
5th stage,	2.4 lb. per sq. in.
Condenser,	0.5 lb. per sq. in.

In order that gauge pressure may be properly indicated, 14.7 lb. must be subtracted from each of the above readings. As the last three readings will then read negative values, it is customary to convert this into inches of mercury vacuum.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies Current Month	each	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly

FOUNDED 1887 AS THE
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CONTENTS

Present Supply of Snow in the Sierras

The delightful rains of the week have added smiles to the face of the farmer and upon the hydroelectric power plant manager a somewhat eased countenance is observed. Even without the recent rains and snowfall, however, contrary to the pessimistic forecasts of many, the present depth of snow at Summit is greater than two recent years, notably the seasons of 1908 and 1910. Records of the depths of snow and rain have been maintained at the point named since 1870 through the co-operation of the Southern Pacific and the Weather Bureau. The station is the highest on the railroad, the culminating point in the long stretch of snowsheds, some 40 miles in all, so well known to travelers on the overland route, between Truckee and Blue Canyon. The elevation of the station is 7,012 ft. above sea-level.

On another page of this Journal will be found the seasonal profile of the depth of snow at Summit, as traced thus far, compared with the two "lean" years above alluded to. In the office of the Weather Bureau in San Francisco are to be found similar profiles for many years past. The interesting thing about these profiles is that, no matter how jagged and irregular the falling of the snow may have been, like the change of the rugged western slope of the Sierras to the sudden and precipitous eastern drop-off familiar to all Sierra-loving mountaineers, the final period of melting seems to follow an almost even law of decrease. So marked has this been found, Professor Jos. Le Conte of the University of California, in our issue of March 25, 1911, deduced a law by which the depths of snow can be foretold weeks ahead with almost positive certainty, thus affording valuable information for those preparing an outing in the Sierras and also furnishing the hydroelectric fraternity with data as to shortcomings in water storage to be expected during the season ahead.

By comparing the present seasonal chart with the two previous years mentioned, it is seen that this season with its packed snow supply now being held back in the high Sierras offers no hazardous nor alarming conditions in the way of extreme scarcity in snow storage. Hence with this assurance from the experiences of well authenticated previous years, if there is any hydroelectric brother who has imagined severe off-year conditions, he may now say to himself, like the fluttering school-girl making her first little speech: "Sit still my heart—sit still."

The Wooden Tower Line

Much is written nowadays relative to the construction of steel tower lines. Little is said regarding the wooden tower. The fact still remains, nevertheless, that in the early days of a new enterprise the eternal question of keeping down first costs until money begins to come in from consumers is a vital issue and often is the determining factor as to whether a new enterprise shall be brought to life or not.

On another page of this Journal will be found the interesting account of a novel wooden tower line construction in northern California.

The rigidity of construction attainable in the wooden tower line as opposed to the wooden pole design usually employed when 60,000 volt transmission is undertaken is shown by the fact that the spans in this installation average over 500 ft. in length and in one case a gap of 1400 ft. has been successfully crossed. The pliability of wooden towers as installed in the Northern California project reaches its fullest exemplification in rough unaccessible country such as is encountered in that portion of California.

The greatest defects met with under the wooden pole construction in former installations, like the Bay Counties line in Central California, has been the premature rotting of the pole bases or lack of rigidity at cross-arm supports. The cast iron anchor plates embedded in concrete, together with the channel iron construction used in the cross-arms, adds strength in places where weakness is as a rule felt in tower construction of this type.

The guy wires used for each tower unquestionably lessens vibration and aids materially in the taking care of unbalanced strains. The extra precautions observed every fifth pole in securing additional stability by heavier construction still further accounts for the success achieved.

The tabulated cost of line per mile shows that in a rough country the cost of material used is almost exactly equal to the additional outlay necessary for the complete installation, after all labor items and miscellaneous accounts are taken into consideration. This table of costs, indicating a total expenditure under $1800 per mile for a high tension transmission line of the proportions described and over the mountainous country encountered, gives a clear idea of the economy of reinforced wooden construction as compared with solid steel towers in the early days of a new hydro-electric enterprise.

For a Greater West

The conditions today looking toward substantial and rapid development in the great western slope of America are without a parallel in the history of nations. It is indeed true that the discovery of the Western Hemisphere by Christopher Columbus in 1492 was an event which still makes the entire world pulsate through and through in contemplation of the endless possibilities opened to civilized man in expanse of territory and acquirement of untold worldly riches. Centuries, however, have been required to make the dreams of early explorers a concrete reality. Lack of rapid and effective means of travel coupled with the absence of all the advance in invention accomplished in the last few years, have saved for the present generation the witnessing of the crowning of commercial supremacy in a section of America where fifty years ago only a few could have dreamed of such a world-beating triumph.

The casual reader of the present day periodicals is overcome with the immense preponderance of subject matter given to topics concerning Alaska, the Pacific Coast, Western Canada, the islands of the Pacific or the Orient.

History making incidents daily accelerate this discussion. The countless human souls in China are just awakening to their latent possibilities. The cities of the Pacific Coast—Los Angeles, San Francisco, Portland, Seattle, Vancouver and Victoria occupy a position almost on a perfect meridianal line of commercial balance or center of gravity between the Orient and the present financial centers of the world. It requires little stretch of imagination to picture in the fierce commercial struggle ahead, the transferring or readjusting of old centers to meet new conditions in world progress.

The cities of the West have built rapidly and built well. Yet it behooves all sections of the West to still further awaken to the gigantic responsibilities immediately before them. Centralization of common interests is needed, while on the other hand decentralization of interests which are purely local should be encouraged in every section. The splendid work now being done in every district of the West to prepare good roads for 1915 is undoubtedly doing more toward centralizing boosting effort than any other one thing.

The petty squabbles or jealousies, which occasionally crop out in various quarters may for the common good be done away with. How foolish does the continual and everlasting "patty-patter" in the contention of the name for Mt. Rainier or Mt. Tacoma by citizens of Seattle and Tacoma appear to residents of California. Likewise the continual "dribble" of weather sharks and local enthusiasts as to whether Los Angeles has a better climate and more wholesome business prospects than San Francisco, must give many occasions for inward chuckling to the cities of the Northwest. As to whether Portland has the vessel of biggest tonnage putting out of any western port may temporarily bring chagrin to Seattle but it makes little for the upbuilding of a Western Empire. The West is big enough and resourceful enough for all. It behooves all to put away swaddling clothes and present a united front to the world, for the world is big enough and varied enough to want every nich and corner with all the diversifications represented in our Western Empire.

Not the least among the things to be brought about by 1915 is the still further getting together of the great commercial and populous centers now already existing on the Coast. The cities around San Francisco Bay may well consider the world power they would present by uniting into a greater San Francisco. A city of a million people, centralized in interests for all those things which result in good from centralization such as financial and engineering undertakings, decentralized into burroughs for interests of purely a neighborhood nature such as educational work, would present to the world a western power and glory never dreamed of by the visiting "wise men from the East" in 1915.

PERSONALS.

E. L. Baker, who has light and power interests at Red Bluff, is a recent San Francisco visitor.

Bertram Smith, representing the U. S. Light & Heating Company of Buffalo, N. Y., is at San Francisco.

S. G. McMeen has accepted the management of the Columbus Railway & Light Company at Columbus, Ohio.

A. E. Chandler, secretary of the American Engineering Corporation of San Francisco, is in Phoenix, Arizona.

F. G. Baum, of F. G. Baum & Co., has returned to San Francisco after an interior trip on electrical engineering business.

F. M. Ray has been chosen by the city council of Oakland, Cal., as expert adviser in fixing gas and electric light rates.

Rudolph W. Van Norden, consulting engineer, has returned to San Francisco from an extensive trip through the Northwest.

S. G. Russell of the Northern Electric Railway Company, with headquarters at Sacramento, was at San Francisco during the past week.

H. H. Noble, president of the Northern California Power Company, made an inspection trip covering a part of the system during the past week.

F. D. Fagan, sales engineer with the General Electric Company, recently gave an illustrated address on methods of illumination at Nevada City, Cal.

F. O. Sievers of the Pacific Coast sales department of the Fort Wayne Electric Works, has returned to San Francisco from a Southern California trip.

H. G. McMillan has joined the sales corps of the Fort Wayne Electric Works, being attached to the mining department, with headquarters at the San Francisco office.

P. M. Downing, engineer of operation and maintenance of the hydraulic section of the Pacific Gas and Electric Company, visited the De Sabla power station during the past week on an inspection tour.

H. R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco from Los Angeles in his automobile after spending several days in the south in connection with some large deals for his companies.

R. B. Elder, district agent for the Ideal Electric Manufacturing Company and Pacific Coast representative of the Moloney Electric Company of St. Louis, has returned to the Coast after an extensive tour of the factories and is now at Los Angeles.

R. M. Searles, vice-president of the Rochester Light and Power Company, is making an automobile tour from San Francisco to San Diego, visiting a number of electric power stations en route. He will return to San Francisco within the next week or two.

H. T. Edgar, manager of the Seattle division of the Puget Sound Traction, Light & Power Company, has announced the following appointments: **G. B. Harrington,** assistant to the manager; **Morton Ramsdell,** sales manager; **W. J. Grambs**, superintendent of light and power; **A. L. Kempster** superintendent of railway; **G. P. James,** chief engineer; **E. C. Gaumnitz,** purchasing agent; **George Carson,** claim agent.

Cecil P. Poole, who has been the junior editor-in-chief of Power for the past seven years, has severed his connection with that paper and will on May 1 engage in consulting engineering in Atlanta, Ga., in partnership with Lamar Lyndon, of 60 Broadway, New York. The firm will operate as the southern branch of Mr. Lyndon's New York office, which will continue as heretofore. The Atlanta office will be conducted by Mr. Poole.

TRADE NOTES.

The General Electric Company has secured two orders for transformers for the Great Western Power Company for use on the Valley lines. Each contract calls for three W. C. 60, 750 k.v.a., 22,000 v. primary, 2400 v. secondary, transformers.

The California Electric Supply Company, 643 Mission street, has added to its stock a complete line of insulating materials and specialties. Everything needed in electric railway repair work is included. Joseph G. Lazarus, the sales manager, is calling on the city trade with the new line.

The General Electric Company has secured a contract for the construction of two 10,000-kw., water-wheel type, three-phase generators for the California-Oregon Light & Power Company. These will be direct connected to two 18,000-h.p. turbine water wheels which are to be constructed in the San Francisco works of the Pelton Water Wheel Company.

David Dow & Son, of Seattle, Wash., have purchased the motors the Seattle Electric Company kept on hand for rental purposes. The taking over by the Puget Sound Traction Company of the Seattle Electric Company has caused the latter concern to dispose of all their rental stock and Dow & Son willu pursue the same plan of renting motors that the Seattle Electric Company has followed.

C. F. Braun & Co., mechanical engineers and contractors, San Francisco, announce the addition to their business of a complete department for the treatment of water, including softening, filtering, sterilizing, and distilling, for domestic, municipal, manufacturing, railroad, hospital, boiler feed, and other services, including equipment from the American Water Softener Company, Forbes Company, and James Beggs Company.

The Allis-Chalmers Company has secured a contract for the complete power equipment for the Hammond Lumber Company's new sash and door plant at Los Angeles, which is to be erected at a cost of about $250,000. A new style Allis-Chalmers Corliss engine, 24x42, will be direct connected to a 575-kw., 480-volt a.c. generator, which will furnish current for a number of electric motors to be installed throughout the factory buildings.

ELECTRICAL CONTRACTORS' NOTES.

Paul Butte of the Butte Electric & Engineering Company is in Portland on business.

Harry Tittle, manager for the John G. Sutton Company's electrical department, has been laid up with tonsilitis.

The Sierra Investment Company is taking figures on a fifteen-story building on Stockton street between Sutter and Bush.

District Local No. 1, California State Association of Electrical Contractors, started a general advertising campaign at its meeting, Friday, April 26th.

H. Reid, manager of the electrical department of the Pacific Fire Distinguisher Company, is making a trip to Portland and Seattle in the interests of his firm.

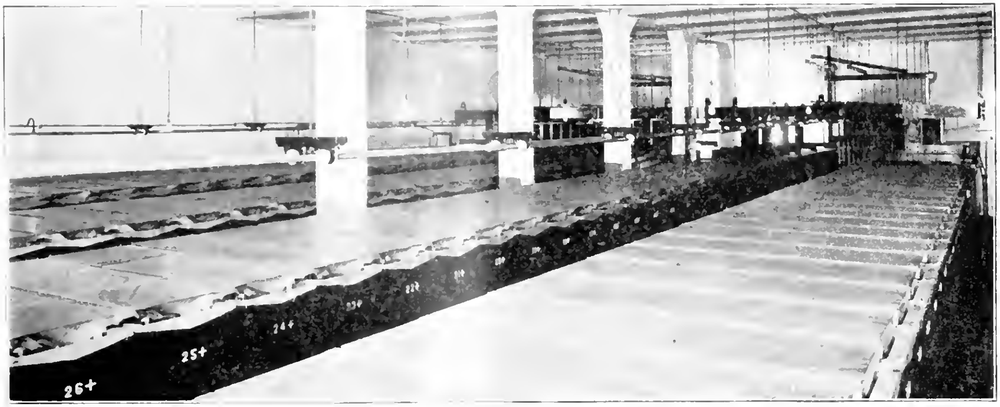
The secretary of the Electrical Contractors' Association will pay ten dollars to the party sending him by June 1, 1912, the best "schedule of a course of education" from which a series of papers can be selected that will benefit the electrical contracting, jobbing and retail supply business.

The contractors and dealers' convention was started at the Builders' Exchange Monday, April 29th. The following officers were elected: Jesse Steer, president; W. S. Hanbridge, vice-president; W. S. Scott, secretary; W. E. Burnham, treasurer. By-laws committee was appointed and everybody satisfied that at last the specialty contractors were under way for proper organization.

INDUSTRIAL

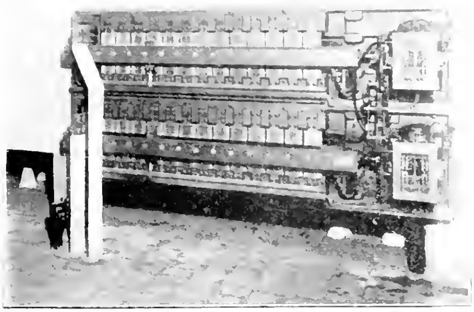
THE LARGEST STORAGE BATTERY INSTALLATION.

Electric light and power companies fully appreciate the value of having a reserve supply of electricity so that their customers can always be assured of uninterrupted service. They realize that to operate their plants without a reserve is to incur the risk of interruptions with constant trouble to their customers; while on the other hand, a proper reserve of current forms a highly valuable insurance which is a guarantee to customers of continuous service.



View of Battery Room Showing End Cell Copper.

For this reason many of the large electric lighting and power companies are installing enormous storage batteries capable of furnishing a large portion, if not, the entire amount of current necessary, for short periods of time.



High Speed Motor Driven End Cell Switch.

Unusual demands for current are caused sometimes by temporary accident to electric generating machinery, or by the sudden darkness preceding a heavy thunder storm, or, as happened last winter in New York City, by a heavy snow fall, which within ten minutes increased the demand for current on the New York Edison Company's systems from 100,000 h.p. to 166,000 h.p. In this case the rate of increase of current was so rapid that it was impossible to connect additional engines with sufficient rapidity to take care of the load and the storage batteries were called upon to meet the emergency, and thus save New York City from darkness.

The largest single storage battery ever installed has been placed in service in Baltimore by the Consolidated Gas, Electric Light & Power Company. This battery is to supply current in the possible event of failure of supply from the Westport power station and the McFall's Ferry hydroelectric plant. The cost of the building, grounds and storage battery amounts to about $100,000.

This battery was manufactured by The Electric Storage Battery Company of Philadelphia and consists of 152 cells of type H "Exide," each cell containing 133 plates, making a total of 20,216 plates. Each of the 152 lead lined wood tanks measures 4 ft. 2 in. in height, 21¾ in. in width and 6 ft. 6⅞ in. long. The total weight of the entire battery equipped with plates and electrolyte is approximately 1,079,200 lb. Fifty-two cars were required in transporting the battery and its constituent parts from Philadelphia to Baltimore. The top of the cells are fitted with heavy glass plates to prevent the electrolyte from splashing over while the battery is being charged and to reduce the evaporation of the electrolyte. The cells are arranged in four rows of 38 each and are connected with copper busbars. The floor space covered by this battery is 45 ft. by 116 ft.

This "Exide" battery will deliver 44,000 amperes at 250 volts for six minutes or 11,000 amperes for one hour. The capacity at the six-minute rate is approximately 9000 kw. The battery will be able to carry the entire direct current load to supply the power and lights supplied by the present power plant for a period of one-half hour for ordinary demands. During the day time when few lights are in use or in the early morning hours when both power and light demands are reduced, it will carry the load for several hours, of course depending upon the magnitude of the load at the time of the discharge. It is kept constantly connected to the busbars supplying the direct current service, and in the event of any interruption to the power supply, the battery will automatically assume the load without any interruption.

NEWS NOTES

INCORPORATIONS.

TACOMA, WASH. Rainy Valley Electric Company, $25,000, by M. T. Slade, T. F. Palms, et al.

SYNAREP, WASH. The Synarep Telephone Company, which is to build a telephone line connecting this place with Riverside, has been organized.

STOCKTON, CAL.—The Electrical Engineering and Supply Company, $25,000, subscribed $7500, by A. F. Flanagan, B. F. Wellington and Henry Adams.

SAN FRANCISCO, CAL.—The California Gas Securities Company, $100,000, shares $100 each, subscribed $500, by W. G. Loomis, W. H. Cunningham, W. R. Bacon, N. F. Wilson, O. Petroff.

LOS ANGELES, CAL. American Power Company of California, $2,000,000, subscribed $7, by N. O. Harmon, C. M. Ferre, R. M. Blodget, H. Waterman, S. J. Powell, G. E. Harpham and W. A. Harmon.

PASADENA, CAL. Articles of incorporation have been filed for the Jepson-Salisbury Company. The directors are Faye L. Hepson and Lewis Salisbury. They have taken over the electrical contract business formerly managed by Frank C. Sweetzer at 43 E. Union street.

SALEM, ORE.—To create water and electrical power and to promote irrigation projects is the purpose of the Mount Jefferson Power Company, which has filed articles of incorporation. The chief place of business and headquarters of the company are to be in Salem. The stockholders are: R. H. Rutherford, H. J. Lanway and Homer Rutherford. Capitalized at $5000.

SEATTLE, WASH. Articles of incorporation of the Seattle, Kenwood & Lake Forest Railway Company have been filed with capital stock of $400,000. They propose to construct an interurban line, leaving Seattle at some point north of Ravenna Park, running in a northerly and northeasterly direction, passing through Kenwood, a new town located about two miles north of Seattle where the company proposes to establish its base of operations and build repair shops, car shops and barns, etc.

SACRAMENTO, CAL.—Articles of incorporation of the Sacramento Valley Electric Railroad have been filed. The line's estimated total length is given as 160 miles. The directors are Charles L. Donohoe of Willows, H. W. Manor of Willows, E. L. Sisson of Red Bluff, L. P. Klemmer of Willows and J. Keith Jr. of Willows. According to the rout of the line, as given in the incorporation articles, it will run from Red Bluff southerly through Tehama, Glenn, Colusa and Yolo counties to Woodland, and then southeasterly through Davis and Dixon to connect with the Oakland, Antioch and Eastern. The branch line of the Sacramento Valley Electric will run from the main line through Williams to Colusa, on the Sacramento River, following the precedent of the Southern Pacific, which recently began work on a branch to the same town. The capital stock of the new company is given at $5,000,000.

ILLUMINATION.

SOUTH BEND, WASH.—The City Council is considering a proposal to place cluster lights along the main business street.

DUNCAN, B. C. The City Council has resolved that an engineer be secured for the purpose of investigating the best means of installing a city light and power plant.

ELGIN, ORE. A franchise has been granted to the Eastern Oregon Light & Power Company of Baker City, giving it authority to install a light and power system in this city.

PORTERVILLE, CAL.—An application has been made to the Supervisors for a franchise for a period of 50 years, to construct a system of gas pipes along certain highways and roads in the county of Tulare. Sealed bids will be received by the board up to May 13, for the sale of said franchise.

WALLA WALLA, WASH.—Bids for material for a new $30,000 gas plant in this city, to be erected by the Pacific Power & Light Company, have been called for by Chief Engineer McGee, with headquarters in Portland, and as soon as the various bids are submitted and passed upon actual work will be started. It will be a two-story brick building located at Sixth and Rose streets.

SUISUN, CAL.—Several thousand dollars' worth of material for the entire rebuilding of the Pacific Gas & Electric light and power system in this city is here on the ground, ready for use. A considerable force of men will soon be put at work replacing old material with new, and materially increasing the efficiency of the present service. The city will be divided into districts to better facilitate service.

SUISUN, CAL.—Work on the Great Western line, which was suspended for several days, is once more in full operation. The Board of Supervisors granted a franchise last week and an additional force of men has been put at work. The franchise requires wires 30 feet above the ground and poles placed three feet from fences. The county reserves the right to remove poles when it sees fit. The line will be rushed to completion.

OLYMPIA, WASH.—With the consent of the public service commission the Puget Sound Traction, Light & Power Company has put on file new tariff schedules affecting rates for electric light and power in Seattle, Everett, Auburn, Issaquah, North Bend, Puyallup, Snoqualmie, Sumner and Ruston and power rates to Tacoma. The new tariffs take effect April 25 and abolish the old flat rates for all users as soon as the old contracts expire. This is done as the result of the adding of such things as heaters, irons, toasters, coffee percolators and the like to household equipment. Formerly the company put in a flat rate to save the cost of installing a meter, but now it is found that meters must be put in at every home to avoid virtual discrimination against the man who has a meter.

OAKLAND, CAL.—T. C. Gillespie, appraisal engineer for J. G. White & Company of New York, has filed with the City Council a report on the holdings of the Pacific Gas & Electric Company in accordance with a request made by the Council sitting as a rate-fixing committee. The figures submitted will be considered at a conference between the Council and the company officials. According to the report filed the valuation of the plant is $7,195,434. The total value of real estate is $1,133,730, of which $395,282 is charged to the electrical department and $636,480 to the gas department. The generating capital for the Oakland plant is placed at $1,029,488 and the transmission capital at $78,194, a total of $1,107,682. The total distribution capital is $2,147,109. The value of the electric substations is given as $885,600. The overhead system for electrical distribution is valued at $993,007, and the underground system at $545,706. The segregation of properties between gas and electric is based on the gross revenue for 1911 for Oakland, 55 per cent of the total

from the gas revenue and 45 per cent from the electric revenue.

TRANSMISSION.

SALEM, ORE.—D. P. Donovan, of Payette, Idaho, has filed on the Clackamas River near Oregon City, for the purpose of developing light and power.

QUINCY, CAL.—O. C. Pratt, president of the Indian Valley Light & Power Company, is arranged to extend the transmission lines from Greenville to Crescent Mills, Taylorsville and Indian Falls, early in the season.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company is applying for a county franchise over several of the roads in the county, with the intention of making extensions of its transmission lines.

REPUBLIC, WASH.—The County Commissioners have granted a franchise to the North Washington Power & Reduction Company to use the county roads for the construction and maintenance of electric light and power lines.

CENTRALIA, WASH.—The Lewis County Commissioners have granted a franchise to the Washington-Oregon corporation for a power line from Chehalis to the south limits of the county. This is the last link in the line from Tenino to Kalama.

GREAT FALLS, MONT.—It has been announced by F. M. Kerr, general superintendent at Lewistown, that work on the power line between here and Lewistown for the Lewistown Electric & Power Company will begin at once. The distance is about 120 miles and the cost will be about $2000 per mile.

RED BLUFF, CAL.—The Victor Power Company has filed notice of an increase of its capital stock from $250,000 to $500,000. The subscribed stock of the company amounts to 230,918 shares at a par value of $1 per share. The directors of the company are James H. Sharpe, P. H. Coffman, George C. Garrett, A. F. Fletcher and Alex Buick.

PORTLAND, ORE.—Plans involving the expenditure of at least $10,000,000 in the development and distribution of electrical energy have just been completed by the engineers of the Northwestern Electric Company. The plans will be carried out regardless of whether or not the Portland franchise is obtained. The Puget Sound cities offer the field for the intended operations of the company. These and all the cities of Western Washington will be invaded, according to an announcement made. The power is to be generated on Lewis, Klickitat and White Salmon rivers and all arrangements have been made for the extension of existing development plants on these streams and the construction of additional ones.

FAIRBANKS, ALASKA.—Judge Ovefield has granted the application of Receiver Charles Joynt, of the Tehama Electric Company for permission to sell the property, and August 1 was fixed as the date of the sale. The liabilities are more than $100,000. The Tanana Electric Company was established in the early days of the camp to furnish electricity for light and power in the mines on Cleary, Dome and Vault creeks. In early days the plant was situated below the mouth of Cleary and wood was used to furnish power. This was expensive, while the plant was inadequate to meet the demands. The Scandinavian American bank of Seattle and various local men financed a plan for the purchasing of larger machinery and the installation of a water power plant in 1907 on Poker creek, which enters the Chatanika River above the mouth of Cleary. This move was not successful, due to insufficient water in summer.

LOS ANGELES, CAL.—Public utility companies will be ordered to obtain franchises to place poles and wires in the streets of Los Angeles and will be subjected to many other regulations which will tend to have a deterring effect upon indiscriminate use of the streets for this purpose if the City Council adopts the report of the Board of Public Works, enclosing suggestions from the Board of Public Utilities. Following are the principal suggestions for the proposed ordinance: "That it shall be unlawful to maintain poles or wires in any public place without a franchise; before placing or removing a pole written application so to do must be filed with the Board of Public Works; deposits to be made and inspection fees charged as provided in ordinance governing excavations; poles to be placed on the inner edge of the curb, not closer than 100 feet apart, etc., as provided in ordinances Nos. 1086, L. A. G. & E. Corp., 1087 L. A. Ry., 2921 Edison Elec. Co. 4242 Pac. L. & P. Co., these ordinances also specifying the distances wires shall be placed from the ground, etc.; the Board of Public Works to have the right to designate the location of any pole or to order same removed; the poles to be thoroughly tamped in their settings in a workmanlike manner and where the surface is concreted this material shall be replaced in full squares, this to avoid patched sections; when removing poles the hole to be properly back-filled, settled with water, and where the surface has been paved, the surface is to be replaced in full squares; where guying of poles is necessary, it must be done in a manner satisfactory to the Board of Public Works; to include all poles, railway signal stands, utility companies, etc."

TRANSPORTATION.

OAKLAND, CAL.—The San Francisco-Oakland Terminal Railways Company announces an extension of the Key Route service on E 14th street to 41st avenue, beginning April 25.

SANTA BARBARA, CAL.—The local street railway system will be constructed with a loan of $5,000,000 from the Los Angeles Trust and Savings Bank. The Santa Barbara and Suburban Railroad Company, which will build the line, is now seeking a 45 year franchise, and the loan is not made unless this is granted.

PORTLAND, ORE.—Immediate construction and improvements announced by the Southern Pacific are as follows: Electrification of Jefferson street line from the city limits to Oswego, Newberg and McMinnville; electrification of West Side line to McMinnville, total distance 100 miles; building of large car shops at Oswego; building of new passenger depots at Forest Grove and McMinnville; construction of cut-off from main line at Salem to Fir on Woodburn-Springfield line; building of electrical transmission stations at Hillsboro, McMinnville and Newberg; building of $100,000 freight house on the East Side.

TULARE, CAL.—At a meeting of the Board of Trade the Four Electric Railway project was endorsed and the support of many of the members of the Board of Trade individually was pledged to the project. It was announced by David Oliver, one of the promoters of the road, that approximately $20,000 had been pledged in subscriptions in this immediate vicinity already. The engineers and surveyors expect to complete the survey to Visalia today. Sixty pound rails are to be used on the roadbed. The entire cost of the road to take in the four cities will be about $800,000. A small bond issue is contemplated and about half a million is to be raised in subscriptions.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, MAY 11, 1912 | NUMBER 19

William G. Kerckhoff, President.

Allan C. Balch, Vice-President.

A. G. Wishon, General Manager.

SAN JOAQUIN LIGHT & POWER CORPORATION

By Rudolph W. Van Norden

Member A. I. E. E., A. S. C. E.

The San Joaquin Light & Power Corporation of today is a natural evolution of one of the first long distance transmission systems to be built; in fact the first system to transmit electricity for power a distance of 36 miles.

The use of water from the streams of the Sierra Nevada under high head for the supply of power to operate gold mines is but part of the history of California, but the transmission of this power for use in the cities of the valleys, remained eighteen years ago as a great problem to be solved by the electrical engineer, backed by the indomitable will and courage of those who were destined to become the pioneers of a tremendous commercial awakening.

In 1896 the old "San Joaquin" plant was placed in operation. Comment of every degree was offered, not only on the boldness of such a transmission but on the daring of the development itself, due to the great head under which the pipe line and water wheels operated. This pioneer plant was operated for a period of fifteen years, while the system in passing through many stages of increased size and usefulness finally demanded its replacement by something more modern and efficient. In 1911, upon the completion of a greater power house, the old San Joaquin No. 1 passed into history.

Originally the system consisted of a transmission for the commercial light and power supply in the city of Fresno. In 1900 this was extended to Hanford, where power was sold to a local company. In 1902 the company, through a sequence of adverse local conditions, became financially embarrassed and was sold to a new company, composed of men, themselves pioneers in the field of electric transmission.

These men, Wm. G. Kerckhoff and A. C. Balch, assumed control December 1, 1902, and A. G. Wishon was made general manager in May, 1903. The fiirst two were connected with the Pacific Light & Power Corporation, as president and general manager, the latter being one of the originators and a part owner of the Mt. Whitney Power Company.

Mr. Kerckhoff's interest in electric power was a natural sequence of good business training and foresight as to the future possibilities of the southern districts of California. In 1879 he became interested in lumber and organized a company which built a mill, this industry playing an important part in the development of Los Angeles. In the course of time a chain of docks was established and a great shipping business developed. In 1898, together with A. C. Balch, Mr. Kerckhoff organized the San Gabriel Electric Company. This was destined to become the nucleus of the great Pacific Light & Power Corporation, of which Mr. Kerckhoff is now president and Mr. Balch vice-president and general manager.

In 1902 the opportunity of acquiring the San Joaquin property, then bankrupt, and the perception of its immense possibilities prompted the formation by these men of the San Joaquin Light & Power Corporation.

Mr. Balch as an engineer realized the feasibility of the plan which has now been established, and the story of this company, together with the subsequent development, until now a territory of 20,000 square miles is served, is one of exciting interest. A. C. Balch is closely associated with the early development of power transmission. Upon graduating from Cornell University in 1889 with the degrees of M.E and E.E., he went to Seattle, Wash., there becoming a member of the engineering firm of Baker, Balch & Co., but later became manager of the Home Electric Company. This was consolidated with several other companies, to form the Union Electrical Company, of which he also was manager for a period of two years. In 1891 he became manager of the Union Power Company at Portland, Oregon, and here built a steam plant near the mill of the Northern Pacific Lumber Company, which for a time supplied all of the power to the local railway system. In 1896 he became associated with Wm. G. Kerckhoff in Los Angeles and in this year built the Azusa plant now a part of the Pacific Light & Power Corporation. In 1902 with Mr. Kerckhoff he financed the purchase of the San Jacinto Company. This deal was the culmination of a sequence of events caused by the pioneer struggle to develop and transmit power for pumping and thus developing a hitherto barren district. Mr. Balch has now many other large electric, gas and water interests.

As a real estate dealer in Visalia, Mr. Wishon foresaw the enormous possibilities to be derived from irrigating land suitable to orange growing about Exeter and Lindsay and set about to devise means to do so. Much of this land, now almost priceless, was bought for $15.00 per acre and much sold at a substantial profit. A plan to build a canal to carry water from the Kaweah River cost all he had and more, and, though unsuccessful, only served as a spur to determination.

After innumerable disappointments and many delays, Mr. Wishon made a sale of real estate netting $4000 and with this Wm. Hammond journeyed to England with the hope of financing the new project, through an introduction to a powerful syndicate by his brother. An elaborate prospectus had been prepared as there were then 25 steam-driven pumping plants for the irrigation of orange groves. The result ot this trip abroad was to interest his brother, John Hays Hammond, in the project, and he agreed to furnish the necessary capital, offering Mr. Wishon and Wm. Hammond a fifth interest. This offer was accepted and a promise was made that within one month the money would be ready.

So eager was Mr. Wishon that he immediately visited all existing plants to learn if possible the manner in which the new problem of power transmission was being handled. With a good understanding of the primary principles but without financial aid or advice, he went into the mountains and rented mules from the Sanger Lumber Company, bought timber and hauled 1,000,000 feet of sawn redwood timber to the power site, to be used in the construction of a flume. Working in a frenzy of eagerness, sleeping under wagons and spending $15,000 of money furnished by himself, he completed six miles of flume. Meanwhile the power plant was constructed with all abiding faith of an eagerly waiting market.

But steam pumps were doing the work successfully,—arguments, cajolery, all, were of no avail. A mass meeting of farmers was held to hear reasons for the adoption of the new power, but without results. it looked as if the builders of the plant really were dreamers, and that they had only a white elephant as a tragic ending of their hopes. There was some lighting business, it is true, and the steam plant in Visalia with its business had been purchased, but it did not begin to pay expenses.

Then there was an idea—a big idea. A few farmers were approached and told that the company would install the motor and equipment for pumping without charge, if satisfied the farmer could pay for the outfit in six annual installments and 6 per cent interest, that the company would connect to existing pumps and if not satisfactory there would be no obligation. He had already told his plan to a Visalia banker and asked for a loan of $25,000 to buy pumps and equipment. Again he was laughed at. But a dozen farmers agreed to the plan and armed with the signed agreements he made application for the loan from a San Francisco banker with whom he was successful. The starting of the first pump was a great event, but it was a sad day for the jeerers.

Within a year all twenty-five plants for which the loan provided had been installed and the company was more than paying expenses. The next year was one of rapid growth. Thus it was that A. G. Wishon emerged from a purely commercial pursuit, one of the pioneers of electric transmission development. In 1903 Mr. Wishon took the management of the newly formed San Joaquin Light & Power Corporation and together with and under the direction of Mr. Kerckhoff and Mr. Balch was destined to transform much of the San Joaquin Valley, a vast semi-arid waste, into a gigantic garden for the support of millions of souls.

Description of Territory.

Intake Tower at Crane Valley.

SOME 20,000 square miles embraced in the great San Joaquin Valley, the southern half of the great central valley of California, are served by this company. This territory extends from Merced on the north in a southeasterly direction for 200 miles and from the Sierra Nevada mountains on the east to the Coast Range on the west, a distance of 75 miles. Included in its scope are the counties of Merced, Mariposa, Madera, Fresno, Tulare, Kings, Kern, San Luis Obispo, Santa Barbara and Monterey, equal to the combined areas of the States of New Hampshire, Massachusetts and Connecticut. Throughout this expanse there is not a section that is not or cannot be reached by electric wires.

There are a number of flourishing cities, two of them, Fresno of 40,000 and Bakersfield, of 20,000 population. But this, except as evidence of prosperity, is not an indication of the resources of this region, for it is the rural and mineral districts that give greatest promise in the cultivation of the fertile soil or the freeing from nature's treasure house, its wealth of liquid fuel.

The power system is operated in two main divisions. The northern with its nucleus at Fresno, covers a great and fertile agricultural district, and, reaching high into the Sierra Nevada mountains, embraces the two principal hydroelectric power plants on the San Joaquin River which ordinarily supply a large part of the current for the entire network. The southern division includes the Kern and Midway oil fields, the city of Bakersfield, where the office and directing head of this division are situated, and a great sweep of country, at present largely undeveloped, but whose potentialities can only be appreciated by viewing what has already been done by the application of water and then imagining the hundreds of sections and even

Kearney Drive, Fresno.

townships which stand ready to produce as bountifully at the will of man.

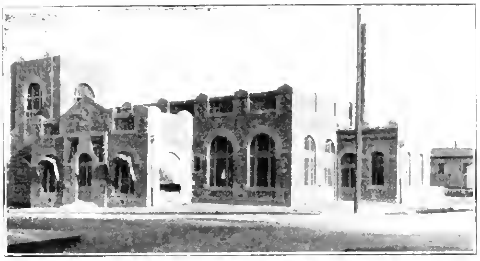
The district about Fresno has long been known for its marvelous fertility, and illustrates what can be done by irrigation from the rivers. The city is one of wide shaded streets, handsomely built business blocks with many imposing public buildings of steel and stone, strong banking houses and large mercantile enterprises of varied character; in short presenting every evidence of unusual and well distributed wealth. For miles around, but particularly to the east of the city, are thousands of acres of vineyards which supply the great wineries and raisin driers for whose products this district is world-famed. To the north is the large park which was given to the city some six years ago, under the provision that $200,000 be spent in its improvement. This has resulted in an arboreatum which any city many times the size of Fresno might justly envy. The sight which visitors are shown with greatest pride is the Kearny Drive, a magnificent avenue leading seven miles from the city, to a great country estate and lined on

Fresno Court House.

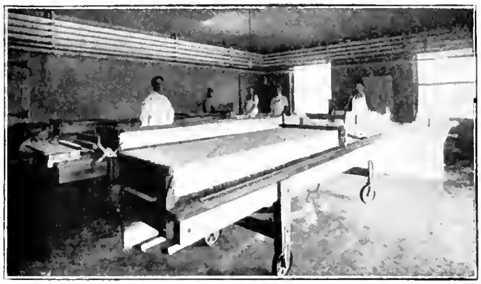
both sides with giant palmettos behind which stand stately eucalyptus trees.

To the north, after crossing the San Joaquin River into Madera County, is a country equally susceptible of cultivation, but less developed because of the lack of irrigation possibilities. Here then, is where the opportunity for motor pumping becomes more evident. For water is almost at the surface and many a conservative farmer, who required a lot of "showing," is now irrigating his six crops of alfalfa and reliable fancy fruit trees, where, not so long ago he raised a crop of wheat,—if it happened to be a "good year"—and he has become the best boosting advertisement for the sale of power that can be obtained. These conditions embrace the district to the northernmost limit at Merced and extend across the valley so as to take in the west side towns of Los Banos, Dos Palos, and Mendota. Between these towns and the Coast Range is an immense area of gently sloping land capable of the highest cultivation. Water on the west side, however, is not so easily obtained as in the center of the valley or the east side. A pumping project, which will require 14,000 h.p. in large units and which will draw water from the river bottom lands is now being undertaken to distribute it over this section.

South from Fresno, through Fowler, Selma, Kingsburg and then easterly through Dinuba, Exeter,



Creamery at Fresno.



Creamery Interior.

Visalia and Lindsey to Porterville, a veritable garden of Eden is disclosed—all through the touch of Nature's magic wand—water. In many of these sections the electric distributing lines become a network following crossroads and lanes, for the well-to-do farmer,—and they are all of this class,—must have electricity, not alone to drive the pumps, but for a generous domestic use.

Nearing the foothills and extending well up on their slopes are the orange orchards, not in isolated patches, but in solid ranks, mile after mile as far as the eye can reach. It is here that the possibilities of irrigation are most vividly illustrated. For there are many problems, each differing in the manner and method of handling the water but all dependent upon the ever-ready motor. The future possibility of this country is nowhere better shown than here; for this orange producing soil extends in a solid unbroken strip, five to ten miles wide and one hundred and fifty miles long following the Sierra Nevada foothills, past and beyond Bakersfield to the end of the valley, where meet the two mountain ranges which bound it.

The great valley itself, in a strip fifty miles wide, is equally ready for cultivation, and, with the exception of the west side, water is at or near the surface

Vineyard East of Fresno

This vast area is suitable for the cultivation of alfalfa and fruit, particularly the former as it is a crop easily cultivated and always profitable. Below Lake Tulare there are already several colonies of settlers who within the space of three or four years have reclaimed land which heretofore had been considered but a desert waste. At their limits may be seen vivid examples of this cultivation, on the one side a knee-deep field of alfalfa, verdant and luxuriant, on the other a sparse growth of sage on an otherwise bare plain. In one district below Bakersfield, through which the lines are now built, there is said to be as much land available for fancy orange culture as is at present planted to orange groves throughout the State of California.

The northern and southern division networks are connected through a main transmission line, following the general southeasterly direction of the valley, passing to the west of Lake Tulare, through the McKittrick, Midway and Maricopa oil fields, and thence to Bakersfield. The branch lines of the northern division on the east side and similar circuits running north from the southern division practically meet, but there is now under construction a second main transmission line from north to south which will pass down the east side.

The other branch of the available power market is the supply for operating the pumps, derricks and drills in the oil fields; a business that, ten years ago the lay mind would have thought an idle dream, but now becoming more and more a stern reality, taxing the resources of the company in every direction to supply. The probability of a thirty horsepower installation at each of four thousand existing and operating oil wells furnishes food for much reflection.

Bakersfield is a city which has received its impetus in growth since the discovery of fuel oil. Like Fresno, it is well planned, with a substantial commercial section and strong business enterprises. The surrounding territory, not being in the state of complete cultivation which is true of Fresno, does not afford such great wealth to the city from agricultural pursuits. But the potential values are everywhere evident and the suburban development is as well assured as are the products of the soil when electric current is the medium of raising the underground water. A great sum of money has been invested by the power company in anticipation of the future development of this district and the wisdom of so doing becomes more and more evident as time unfolds.

The southern division boasts of one hydroelectric plant at the mouth of the canyon of the Kern River. This is the smallest of the hydraulic plants but it has done faithful duty since the early days of long distance transmission.

Fresno Homes.

In Bakersfield is the steam auxiliary plant, the standby for the system. This new installation is modern and complete and offers an unfailing source of power in the event of failure of the transmitted power.

The company will eventually build two additional hydroelectric plants on the San Joaquin River. It also owns water rights on the Tule River, and a new plant is under construction. These, together with existing installations, will aggregate 100,000 h.p.

Outside of this territory the company furnishes power at wholesale to other companies, all of which except the Tulare Power Company are owned and controlled by interests coinciding with those of this company. These include Coalinga and the surrounding oil district, Paso Robles, Santa Maria, San Luis Obispo, Arroyo Grande, San Miguel

Stone Canyon and Santa Margarita, and add to the directly operated territory about 7000 square miles.

Business of the Company.

Covering such a vast region as does this system it is natural to expect that many different forms of power consuming enterprises will present a varied market for the sale of power. To the outsider, unacquainted with the wonderful possibilities of the territory covered, it may seem strange at first thought that a scattered score of small cities could offer a market for twenty-five thousand horsepower with an assured future prospect of several times this amount. Let the observer, however, see a few of the irrigating pumping plants surrounded by the magic results of their operation, or, visit the oil-fields with their countless derricks, each one of which, if not already supplied with electric current, is a probable future customer, the wisdom and foresight shown in the conception of this system and the enormous market possibility cannot but be forcibly impressed upon the most conservative mind. For it is from these two great industries that the system can draw its business. Of course there are many other industries forming a part of the market, of a more conventional nature, either in existence or in project, railroads, rock-crushers, mills, factories and immense ice-making plants, to say nothing of lighting and domestic service. But the steady pumping loads of thousands of motors ranging from 20 to 150 h.p., form the backbone of the load and make a business which, fifteen years ago was scarcely conceived.

Orange Grove at Porterville.

Pumping for Water Supply.

A description of the lands suitable for irrigation from wells has been given, but a description of the methods in various localities may be interesting. One of the most striking illustrations of the efficiency of electric pumping may be had in the intensely cultivated districts on the immediate north, south and east of Fresno. This district has perhaps the most complete and comprehensive system of irrigation canals in the state, into which water is diverted from the Kings River. Even with this system, there are lands which are not reached by these canals and it is here that pumping from wells with electric motors has shown highly favorable results in comparison with the cost from canals and with the added advantage of

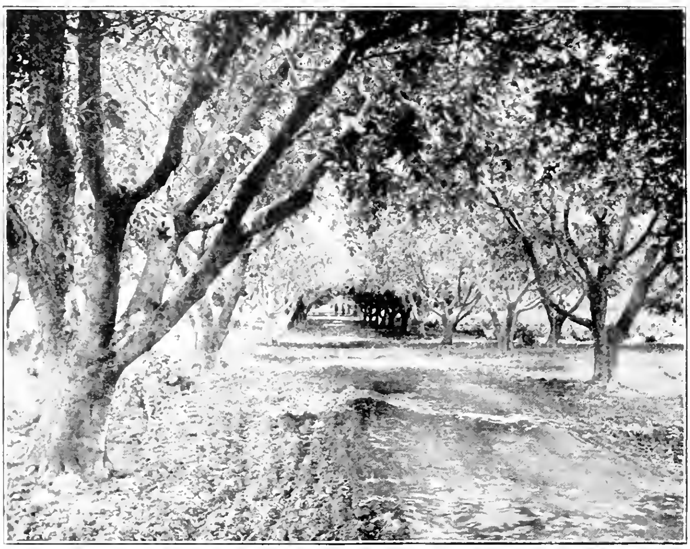
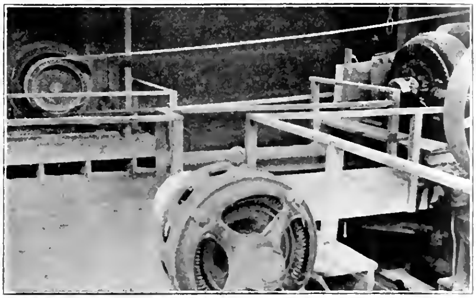


Fig Orchard and Vineyard at Fresno.

having water free from weed bearing seeds which are likely to be distributed from the canals.

Throughout the San Joaquin Valley, except on the western slope, the sub-surface flow is never at a great depth. In the upper section of the territory, extending from the foothills, to and beyond the center of the valley, an unfailing supply of water is found at a depth of 15 to 30 ft. From the San Joaquin River,



Motor Drive in Santa Fe Crusher.

south to Lake Tulare, the water is often within two or three feet of the surface, and in the district about Corcoran, there are a number of flowing artesian wells.

There is seldom any question as to the fertility of the soil except, perhaps, in a few restricted sections in the center and therefore the lowest points of the valley where alkaline deposits have come to the surface, and these lands may be alternately flooded and drained to leach out the minerals. There is therefore full assurance of abundant crops, having invariably suitable soil and an ample supply of pure water.

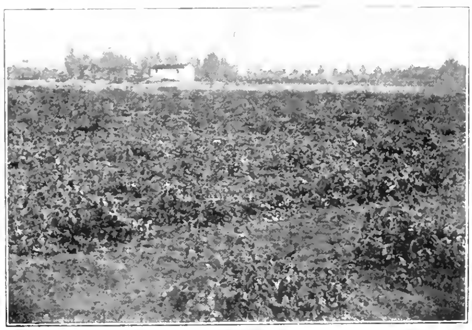
Typical Farm Pumping Plants from Wells and River.

In the northern and eastern sections of the territory may be found the conventional pumping plants, every ready for their duty of irrigation. The arrangement and size depends on the surface grade and the area to be irrigated. In many cases two or more wells supply water for a single pump; in many cases but one well is sufficient. These plants are quite similar and comprise two types. One is the direct connected motor-pump, in which the motor and single stage centrifugal pump are mounted together on a common cast iron base, the unit being placed at the bottom of a pit at practically the standing surface of water. The other form is, as a rule, more or less temporary in character and consists of a centrifugal pump with vertical shaft, placed in a sump at the water level,

Finn Colony Pumping Plant.

the driving motor being belted to a pulley on the pump shaft.

A typical farm equipment of the first named class consists of a concrete lined pit, 8 x 12 ft., with 8 in. walls, in which are imbedded steel I beams with L braces for stiffness. The floor of the pit is 27 ft. below the ground surface. There are two wells 4 ft. apart opening into this pit and between them is placed the pumping unit which consists of a Westinghouse 20 h.p. 3-phase induction motor, direct connected to a No. 6 centrifugal pump. Over the pit is erected a neat wooden house which contains the controller, switch and meter. The pole structure nearby carries three 7½ kw. 6600/440 volt transformers, these are star connected on the primary side to the 10,000 volt lines. In providing service of this order, the



Vineyard Pumping Plant.

company assembles and arranges the outfit in accordance with the standards adopted for the system and makes the installation for the customer. The latter pays outright for the pumping unit, the transformers and the section of transmission line which it may be necessary to build from one of the distributing lines. In building a line into a certain locality, the

locations of the wells of prospective customers are determined as nearly as is possible, and the line is located so that the least possible burden of cost will fall on the customer for his line.

In the plant described above, 1025 gal. per minute are delivered against a head of 42 ft., the vacuum being 14 ft. This requires 18.8 h.p. measured at the motor, which shows an efficiency for the pump of somewhat over 60 per cent.

The cost to the company of installing a rig of this sort, including the hanging of the transformers and making all connections is about $75.

Following is a list of material and costs of a standard pumping equipment:

Labor and Material for Equipment for Installing Electrical Motors and Transformers.

	Size	Amount	Cost	Size	Amount	Cost
Motor, 220 volt*	3 h.p.	1	64.85	30 h.p.	1	513.80
Transformers, 6600 volts	2 kw.	3	177.90	10 kw.	3	393.00
Pole	35′	1	8.00	35′	1	8.00
Crossarms	Style D	2	1.60	Style D	2	1.60
Crossarms	Style G	2	1.60	Style G	2	1.60
Lag screws and washers	½x3½	6	.09	½x3½	6	.09
⅝″x16″ bolts and washers	⅝x16	4	.30	⅝x16	4	.30
⅝″x14″ bolts and washers	⅝x14	2	.14	⅝x14	2	.14
⅝″x12″ bolts and washers	⅝x12	2	.14	⅝x12	2	.14
Sets 6600 volt line fuses complete (warning signs)	Set	3	18.00	Set	3	18.00
1′ blocks	1′	3	.30	1′	3	.30
Type A condulets	¾″	2	.54	2″	2	1.90
Type B condulets	¾″	1	.40	2″	1	1.28
Type F condulets	¾″	1	.60	2″	1	3.00
Conduit ells	¾″	6	.66	2″	6	3.00
Conduit straps	¾″	12	.06	2″	12	.12
Conduit ground clamp	¾″	2	.28	2″	2	.28
Conduit	¾″	80′	5.12	2″	80′	16.00
Angle iron frame and board	2′	1	4.00	2′x6″	1	5.00
⅛″ sheet asbestos	⅛″	2′x4′	.35	⅛	3′x4′	.41
3 P. S. T. switch, 250 v., and screws				150 A	1	4.50
3 P. D. T. switch, 250 v., and screws	25 A	1	1.15			
Fuse block, 3 p., 250 v., and screws	25 A	2	.80	150 A	1	3.50
Cartridge fuses, 250 v. (running)	10 A	3	.45	95 A	3	1.29
Cartridge fuses, 250 v. (starting)	20 A	3	.66	150 A	3	1.29
R. C., D. B. flexible cable				No. 1-0	300′	39.00
Primary fuse wire	½ A	12′	.05	3 A	12′	.10
R. C., D. B. wire	No. 10	300′	4.14			
W. P. wire	No. 8	50′	.76	No. 6	50	1.14
S. D. bare wire	No. 6	100′	1.40	No. 6	100′	1.40
H. D. bare wire	No. 8	400′	3.50	No. 8	400	3.59
10,000 volt insulators		12	1.56		12	1.56
2,000 volt insulators		12	.48		12	.48
Standard iron pins	8″	16	3.20	8″	16	3.20
Locust pins		8	.16		8	.16
Black pipe	⅜	18′	.45	⅜	18′	.45
Guy boxes		1	.75		1	.75
Pole steps		21	1.05		21	1.05
Lbs. solder		1	.30		2	.60
Gal. gasoline		½	.15		1	.25
Loom	⅜″	20′	.80	½″	20′	1.00
Porcelain tubes	5-16x3″	18	.12	5-16x3″	18	.12
Porcelain tubes				¾x3	12	.24
Lbs. solder paste		¼	.08		¼	.16
Rolls friction tape		3	.39		3	.39
Rolls rubber tape		2	.50		2	.50
Conduit box and nails (to fit conduit)		30′	2.85		30′	3.75
Total cost of material			310.68			1037.11
Overload and low voltage coils					1 set	
Team						
Labor			20.00			36.00
Hotel expense						
R. R. fare & traveling time						
Total cost						

*NOTE.—Prices on motors include sliding base and pulley and on motors over 5 h.p., compensators. Low voltage and overload coils extra. Prices are approximate f.o.b. Bakersfield and are subject to change.

In the district adjoining the hills south of Bakersfield, deep well conditions are met. The land is unusually fertile and with water is particularly suitable for orange culture. The deep well pumps are of the plunger type, the pump cylinders being placed in the well below the water surface. The plunger is operated with a vertical motion by a bell-crank or walking-beam, which in turn is moved in its reciprocating motion from a crank mounted at the end of a counter shaft. To this counter-shaft is belted the driving motor. The whole is enclosed in a suitable wooden house. One of these pumps near Edison operates

Motor Drive for Mine.

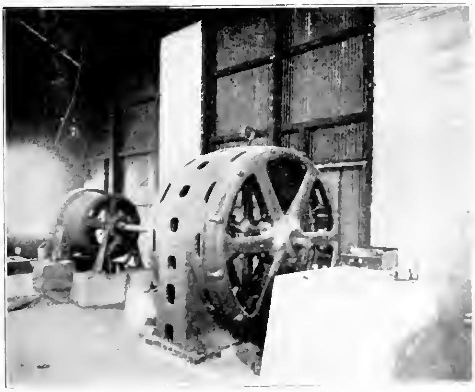
a well 175 ft. deep; the motor is a Westinghouse, type CCL, 40 h.p. The pump delivers 61 miners' inches (statute) of water equivalent to a flow of 1.22 cu. ft. per second. This will irrigate 320 acres of land at the plant level. The power bill amounts to $5.00 per acre per year, allowing one miners' inch to the acre and four irrigation per year. Still other pumps raise water from streams discharging into irrigation canals.

While there are hundreds of these plants installed throughout the territory, with many times the number to be installed as the population increases and the great expanses of uncultivated lands are developed, there are in project irrigation developments on a wholesale scale which will require large blocks of power.

On the west of Lake Tulare, is an enormous dis-

Year-Old Orange Grove Near Bakersfield.

trict of 175,000 acres. It is apparently arid and desert land and of little value without water. There is no substratum of water near enough the surface for economical pumping. Plans have been perfected to pump water from Lake Tulare into a system of irrigating canals, leaving at all times an area of water in the lake of 25,000 acres as a reservoir. This supply is



Deep Well Pumping Installation.

to be supplemented by wells on the east side of Kings River. This will supply abundant moisture for the entire 175,000 acres, will be highly feasible and economical and will require 14,000 h.p. to raise and distribute the flow.

There are already throughout the valley a number of colonies which pump water in large quantities and distribute it throughout the holdings. At the Alpaugh Colony pumps, about 30 miles northwest of Bakersfield, there are seven wells. Each of these wells is equipped with a unit comprising a 20 h.p. induction motor driving a 7 to 8 in. centrifugal pump. Each pump delivers 1500 gal. per min. into a common canal. This carries the water eleven miles to the Alpaugh colony where it is raised 7 feet by a 50 h.p. motor-pump into distributing canals and thereby does duty in irrigating 8000 acres of what is now most productive land. The cost of this irrigation to the colonists is $1.25 per acre per year.

Another vast project is the irrigation of a section containing 250,000 acres west of Mendota, on the west side of the valley. It is proposed to install two pumping plants with units of 500 h.p. to pump from and drain the land adjacent to Kerman, the water being raised by a myriad of 15 h.p. well plants, raising the water to a level sufficient for distribution over the area. This will require altogether about 8000 horsepower.

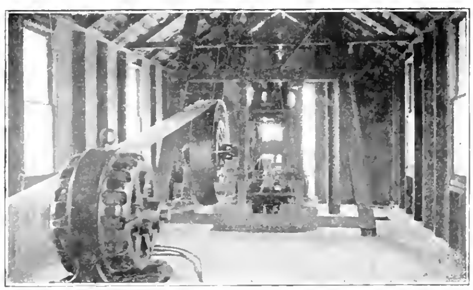
A very interesting use of water from a small pumping plant is illustrated in an orange ranch near Porterville, on which the Skinner system of overhead irrigation is used. In this system galvanized wrought iron pipe is carried through the tops of the orange trees, a line of pipe for every other row of trees; it is supported 8 ft. above ground on 4 x 4 in. redwood poles. Suitable valves are provided so that water may be supplied to any row of pipe at will and the joints are so arranged that the line of pipe may be turned to throw the spray in any direction desired with reference to wind and sun. Holes for the nozzles are drilled in the pipe every four feet and 1/4 in. brass nozzle bushings are screwed into these holes. These nozzles are drilled in three sizes, depending upon the amount of irrigation desired, the smallest hole being not much larger than a horsehair.

In the ranch in question the equipment on one 10-acre sidehill tract is 180 ft. of 1 1/2 in. galvanized pipe, 180 ft. 1 1/4 in., 170 ft. 1 in. and 100 ft. of 3/4 in. The lift of the sidehill is 32 ft. The well supplying water for this installation developes 10 miners' in. of water. It is found that it is possible to irrigate 30 acres at a time. The system cost $150 per acre to install outside of the cost of pump and well plant.

The pumping plant is a 40 h.p. induction motor direct connected to a centrifugal pump placed at the bottom of a stave line pit 22 ft. below the ground surface. The actual power required to deliver 100 in. of water is 34.92 h.p.

The power bill for irrigating 155 acres as at present installed is $144 per month. This figure can probably be lessened as the equipment is increased and the plant becomes more systematized. This method of irrigation has a number of advantages. The water is delivered at a temperature of 65 degrees. This is a good frost preventative as the trees may be kept at near this temperature on cold winter nights. It is necessary to cultivate the ground but once a year and that when fertilizing. Clover may be planted between the orange trees successfully and this is being done.

When this system was first installed the fruit output was two boxes per tree per year. At the present time the crop is three and one-half boxes of fancy fruit. An increase of two boxes per tree pays for the plant the first year. The owner states that it is his full belief within the next three or four years by the use of this system the crop will become ten boxes per tree.



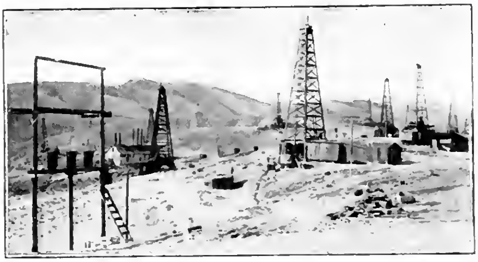
Typical Motor-Driven Deep Well Pump.

Oil Pumping.

The possibility of operating oil wells and derricks with electric motors in place of the steam engines used in common practice opened an enormous opportunity for the disposal of electric current.

The five oil fields in the San Joaquin Valley have about 4000 oil wells. This number is constantly increasing and while wells gradually become pumped out others are brought in in greater numbers.

The conventional operation of oil wells is so well standardized that any new method or system which might be a radical improvement in operating methods


Oil Wells in Coalinga Field Where Motor Drive Has Superseded Steam.

has been extremely difficult of introduction, and the conservatism of operators has been an almost insurmountable obstacle for the electric company to overcome, notwithstanding every advantage in favor of electric operation.

There are a number of glaring disadvantages in the use of steam engines. Principally among these are the low efficiency of the engine, the extreme losses in the transmission of steam, which are aggravated during cold weather, the higher cost of attendance, the almost prohibitive cost of water, and a very great depreciation, especially in the boilers.

All of these features are obviated in the use of motor drives. The costly boiler plant and water distributing system is eliminated, the efficiency of machinery is at the highest point and there are no transmission losses. During cold weather, when there is danger of uncertain operation by the engine due to condensation in the steam pipes, there is a liability of buckling the pump rods, and where there is a sudden increase in the steam pressure there is the danger of breaking the rods. These dangers are greatly lessened with electric drive as temperature conditions have practically no effect upon its operation.

In the Coalinga field a set of boiler tubes seldom last over six months, due to the nature of the water available. Throughout this field it has been shown that the cost of operation, including depreciation and overhead expense, with electric drive will average 40 per cent less than with steam engines. In some isolated cases this has been shown to be as much as 60 or 70 per cent.

The only competitor in point of cost of operation with the electric motor is by the use of a gas engine supplied with natural gas from the wells. The actual cost of operation is about the same. The cost of the installation, however, is somewhat greater. After eight months operation the depreciation costs of the gas engine plant begin to increase and shortly bring the costs of operation to a much higher figure. After ar electric plant is installed, there is practically no depreciation.

There are also no standby losses, the expense of 1unning the plant ceasing when it is not operating. The standby losses in the steam plant are very large and form a serious factor in the general cost of operation.

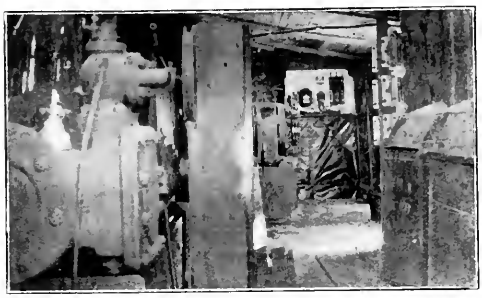
In the Coalinga field the following example of operating cost cover the supply to a group of wells of two-boiler plants having 12 boilers.

1600 lb. boiler compound	$ 72 00
Boiler repairs; taking out tubes, cleaning and welding	165 00
Cost for new flues	64 75
Wages of four boiler men and four helpers	650 00
Cost of 3300 bbls. of oil at 30c	980 00
Total cost of operation by steam	$1931 75
Total cost of electrical operation for above case	$ 715 25

Total cost of electrical operation for above case, $715.25.

It is actually figured in this district that the cost of electricity for pumping a well is $1.00 per well per day. The cost of the motor equipment in comparison tc the steam equipment is startling. A 30/10 h.p. variable speed motor with 3-10 kw. transformers and all connections will amount to about $800. The boiler outfit and piping for a steam plant alone will cost $1200.

The development of the motor drive has been the result of much study on the part of oil well engineers. While different localities require different operating conditions the type of motor and equipment has been fairly well standardized. In pumping, no two wells require the same speed of stroke and the same well may vary not only from time to time, but from hour to hour. Great care must be taken not to overpump and cause the well to "sand up." For this reason a closely graduated variable speed is necessary and it must be possible to control this speed instantly from the derrick. The motor must be capable not only of operating the pump, but also a hoist to be used in drawing the casing and also in drilling and cleaning out. These latter operations require more power than pumping.


Motor Installed in Front of Oil Well Engine.

In order that a single motor may operate efficiently with the various kinds of load, which requires about 6 to 8 h.p. while pumping and as high as a momentary pull of 50 or 60 h.p. when hoisting the bailer, when full, in most cases a two-voltage 30 h.p. variable speed motor is employed. The primary winding on this motor is designed for a delta connection, which enables the motor to develop its full power with a possibility of 100 per cent overload. By throwing a 2-way three-pole switch the stator of the motor is connected to the line in star; thus giving it a high efficiency under small loads. A rheostat and street railway controller throw in and out resistance to the secondary circuit, providing the variable speed feature. This controller is operated through an endless chain with a control wheel on the derrick, thereby

obtaining the fine graduations of control which can be had from a steam engine.

The great difference in speed between the motor shaft and the crank shaft operating the pump beam necessitates an intermediate speed reducing shaft. There are two methods employed to obtain this. One is to introduce a countershaft which necessitates two belts, while the newer and more compact method is a back gear mounted on the motor, thus requiring but one belt between the motor and the crank shaft. The former method however gives the best results due to the flexibility of the belts which allows a cushioning action upon the suddenly applied up-stroke of the pump.

In the Midway and Kern fields where current is supplied directly to the wells by this company, a standard motor equipment assembled at the company's shop in Bakersfield has been adopted. This equipment is efficient and complete and consists of a 440 volt 30/10 h.p. variable speed induction motor equipped with back gear shaft and pulley. The rheostat and controller are mounted together and at the side of the rheostat is a galvanized sheet iron box, with a double hinged door of the same material, the whole lined with asbestos board. Within this box are mounted the main switch, fuses and integrating watt meter. The incoming wires are brought through steel pipe conduit and the connections between the motor and the control are also in steel pipe conduit. This standard rig costs as follows:

1	1½-in. Type F condulet	$ 1.24	$ 1.24
1	1½-in. Type E condulet	.80	.80
6	1½-in. Type A condulet	.70	4.20
70	ft. 1½-in. conduit	.16	11.20
6	1½-in. conduit couplings	.08	.48
10	1½-in. conduit ells	.15	1.50
6	1½-in. conduit lock nuts	.033	.20
6	1½-in. conduit finishers	.05	.30
200	ft. No. 4 flexible R C wire	.051	10.20
50	ft. No. 4 flexible asbestos covered wire	.06	3.00
1	500 volt 100 amp. S T 3 P switch	4.50	4.50
3	500 volt 50 amp. S P fuse blocks	1.00	3.00
3	500 volt 80 amp. cartridge fuses	.75	2.25
3	500 volt 30 amp. cartridge fuses	.75	2.25
18	1½-in. pipe straps	.01	.18
1	1 angle iron frame and box complete, lined with ⅛-in. asbestos board	16.00	16.00
6	1½-in. grounding straps	.14	.84
6	rolls friction	.13	.78
2	lb. string solder	.30	.60
⅛	lb. soldering paste	.64	.08
25	1½-in. x No. 8 wood screws....(per gro.)	.16	.03
30	ft. 1½-in. conduit casing	.125	3.75
			$70.38
	Labor		20.00
	Hotel		
	Railroad fare		
	Traveling time		

Many of the wells cannot be operated steadily due to the fact that the oil would be exhausted after a certain period of pumping. These are known as spasmodic wells and are particularly suitable for single motor installation. Where it is possible to operate a group of wells mechanically from one central point a device known as a jack is used. Jack rigs are particularly noticeable in the Kern field and are operated as follows: An induction motor of suitable size, generally about 50 h.p. is belted or geared to a vertical shaft. This shaft extends through the roof of the enclosing building and on its upper extremity are two eccentrics with bands, similar but considerably larger than the eccentrics of a reversible steam engine. Fastened to the bands are steel cables which extend in the various directions of the derricks which are to be operated. The cables terminate in a walking beam or reciprocating bell-crank which operates the plunger rod of the well. The movement of the eccentrics gives a reciprocating motion to all of the cable lines and thus the wells are all pumped from one motor.

With electric drive it will pay to pump a well which will not deliver over six barrels per day, while with steam the cost to operate per day would equal the selling price of ten barrels. There is, of course, a great variation in the amount of oil a well will give, and this in steady flowing wells amounts to as much as 120 barrels per day.

The change from steam to electric driving may be made in a few hours as the transformers can be set and the motor erected often without stopping the engine. The shutdown then only requires the time necessary to change the belting.

Jack-Rig in Kern River Field.

Portable drilling outfits are used by well drillers and can be moved from well to well. This outfit consists of a 30/60 h.p. induction motor with back gear and controller and a special change gear mounted on the same base. With this means drilling can be quickly and efficiently accomplished.

The actual saving in the installation of motor drive in the cost of operation alone will pay for the motor equipment in 18 months.

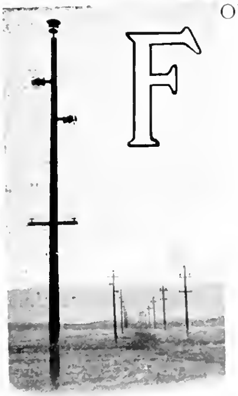
In the Kern River, Maricopa, Midway and McKittrick fields there are now installed 155 motors; in the Coalinga field 42 motors. Contracts are signed for additional installations that will more than double this number.

The first motor installed in the Coalinga field was in June, 1910.

The following statement of the average daily record for electric operation in both pumping and drilling of one of the large companies in the Midway field for the month of January, 1912, is as follows:

Pumping	Meter No. 1	Meter No. 2	Total
Total kw. per mo.	26,912	20,448	47,360
No. of wells	11	10	21
Av. kw. hr. per well per day	78.9	65.9	72.1
Total product'n in bbl.	64,970	45,955	110,225
Kw. per bbl.	0.414	0.445	0.427
Av. daily production.	190.5	148.2	170.4
Av. depth wells	947 ft.	1,419 ft.	1,106 ft.
Drilling			Motor No. 3
Total kw. hours			5,770
Av. per day			231
Av. per foot			0.061
Depth			945
Grand Totals.			
Kw. hours for January, 1912			53,130
Wells pumped			21
Av. kw. hr. per well per day			72.1
Av. production, bbl.			110,925
Av. kw. hr. per bbl.			0.427
Av. daily production, bbl.			170.4
Av. depth wells, ft.			1,106

Transmission Circuits and Equipment.



Main Transmission Lines.

FOUR classes of transmission and distributing circuits have been well standardized by the company. For the long distance transmission of power between the power stations and the main points of distribution, 60,000 volt transmission has been adopted. For shorter transmissions and distribution to secondary stations 30,000 volts is used. For the distribution of suburban and town orchard pumping and oil well service 10,000 volts is employed. In some of the larger towns and cities, 2400 volts is used for distribution, in most cases being a three-wire delta connection from the transformers, but in one or two cases the 2400 volt has been star-connected to give 4125 volts.

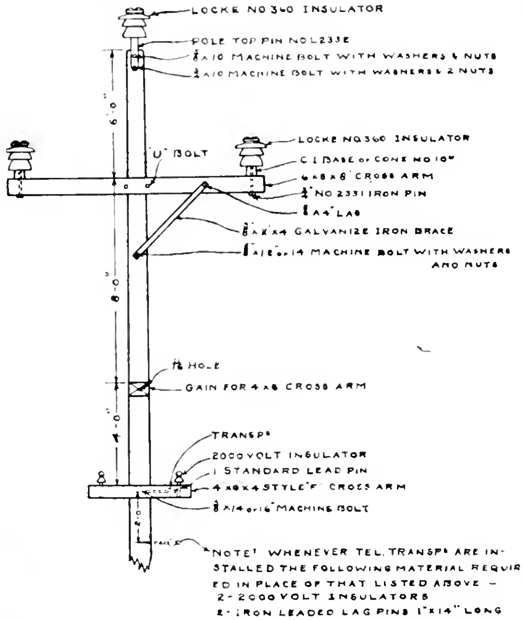
Throughout the system all transmission and distribution lines are star-connected from the transformers, the neutrals being grounded.

30,000 Volt Lines in Foot-Hills.

A spacing distance for poles on all lines of 15 to 16 to the mile has been adopted after a dozen or more years of experience in this section, as being economical and satisfactory under all conditions of operation. There are, of course, some exceptions to this rule in mountainous or rolling country, but by far the largest proportion of lines is in country which is practically level.

The main 60,000 volt transmission lines are mounted on 50 ft. round Washington fir poles. The wires form an equilateral triangle, two of them being at the extremities of the single cross-arm, the third wire being at the top of the pole, mounted on a malleable iron pin. Steel pins are used with lead and porcelain thimbles and standard Locke insulators. The cross-arm is fastened to the pole by the usual gain and a ¾ in. galvanized U-bolt which passes around the pole. In the mountains where trouble has been experienced by eagles in short-circuiting the lines, a novel construction, of mounting two of the insulators directly on the pole, one or either side, is being tried.

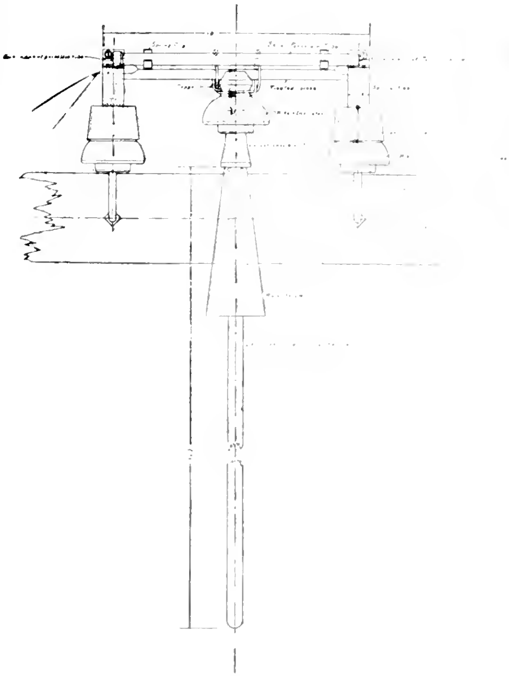
Where the circuits cross a railroad track or other wires, whether telegraph, telephone or power, a novel type of grounded cradle is used. This consists of a structural steel frame extending out from the pole a short distance below the lowest wires of the circuit. At the extremity of this cradle is a U-shaped guard to which the ground connection is made. The poles are so placed that should a wire break at any point it will fall on this cradle and be grounded and at the same time fall free from any possible contact with foreign wires.



Elevation of Standard 60,000 Volt Pole.

Guying is resorted to in the ordinary manner, a wooden insulator being slipped over the guy from its point of contact with the ground for a distance up of about 12 ft. In guying fore and aft, a sling is used which is fastened near the extremities of the cross-arm but just inside of the insulator pins. Either end of this sling terminates in a galvanized ring to which the guying cables are fastened.

Both copper and aluminum wire is used on the 60,000 volt transmission lines. From the power station to the Henrietta sub-station No. 0 copper is used. From Henrietta to Bakersfield No. 000 seven-strand aluminum is used, except where entering substations, all entrance wires being of copper.



10,000 Volt Pole Line Cut-Out.

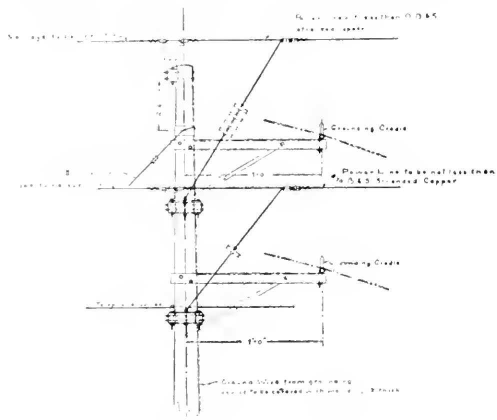
A very successful pole-type cut out for 10,000 volt circuits, mounted whenever a branch is taken from a main line, has been developed and is used exclusively by the company. This consists of a porcelain tube through which passes a fuse wire, mounted on a wooden stick either end of which has a copper blade. The blades engage jaws mounted on insulators, which in turn are held to the arm by a steel bent pin. At the center of the wooden bar on the under side is a threaded socket. In operation the lineman at some distance below all circuits inserts a long stick, the end of which has a male thread and draws the bar and fuse downward to disengage it. This device is simple and positive and costs to manufacture complete, $1.80.

The construction for the 30,000 volt circuits is in two forms. On some of the main lines feeding at this voltage, comprising the older part of the system, it is quite similar to that just described; except

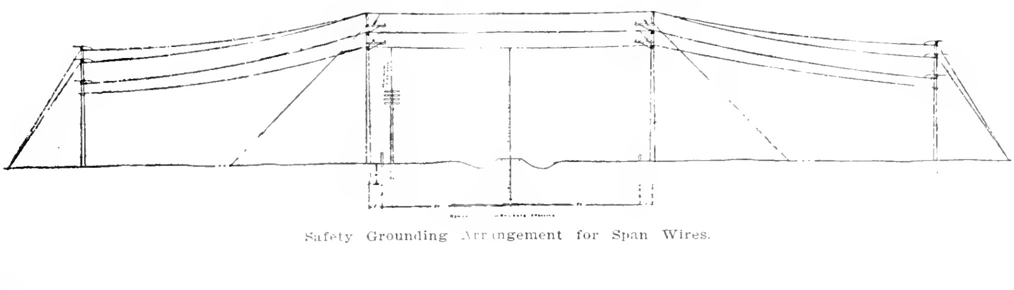
Transmission Line in Midway Oil Fields.

that the triangle is somewhat smaller. The more modern construction, which has been adopted on all of the newer lines and is now standard, is for 40 ft. poles. There is a single cross-arm placed at the top of the pole. This arm carries three insulators; one at each extremity and one in the center. The method of guying and providing for crossing foreign wires is similar to that used on the 60,000 volt lines, but somewhat smaller in general dimensions.

The 10,000 volt distribution circuits are mounted on 35 and 40 ft. round poles, and have a single four-pin cross-arm. Three of the pins carry the three wires of the circuit. The fourth, which is invariably an outside wire, is the ground wire, being the grounded neutral of the system. This arrangement has been found necessary as it is difficult in many



Detail of Grounding Cradles.



Safety Grounding Arrangement for Span Wires.

places to procure a good ground. It also saves the cost of constructing a ground connection at every transformer set. On both the 30,000 and the 10,000 volt circuits copper is used exclusively.

On the 10,000 volt distribution circuits, where there is no possible chance of extension, four No. 8 hard-drawn copper wires are used. For lateral lines there is a possibility of extension over a comparatively smaller territory three No. 6 and one No. 8 ground wire are used. On main feeders three No. 4 and one No. 6 wires are used, all being of hard-drawn copper.

To illustrate the difficulty of procuring ground connections for transformers in the west side oil field district from Maricopa on the south, through the Midway field to McKittrick on the north, a distance of 25 miles, there are but two ground connections, one at Midway and one at McKittrick. The ground connection at Midway is a 2000 ft. well in which a large quantity of charcoal was placed, but in which it is necessary to occasionally pour water to keep the ground in effective condition.

Standard insulators adopted for the various types of line are as follows:

STANDARD INSULATORS.

60,000 Volt.

Pin type	360 Locke
Strain type	273 Locke 2 units
Strain type	1060 Thomas 3 units

30,000 Volt.

Pin type	408 A Locke 1-in. pinholes
Strain type	1060 Thomas 2 units
Strain type	273 Locke 1 unit

10,000 Volts.

Pin type	298 Locke
Pin type	9046 Ohio Brass Co.
Strain type	1060 Thomas 1 unit

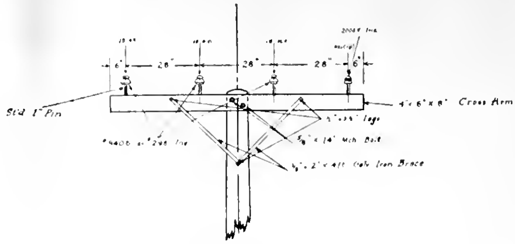
4,000 Volts and Under.

Pin type	44 Locke
Pin type	9990 Ohio Brass Co.
Strain type	2 Goose Eggs

The costs and specifications of the various types of line are carefully kept by the company and tabulated in such a form that it is an easy matter for the company's business agent to figure quickly the proper cost of making an extension to a new customer. The cost of a main section of 10,000 volt distribution is as follows:

Estimate of Labor and Material for Building One Mile of 10,000 Volt Line. With Three No. 4 and Ono No. 6 Wire.

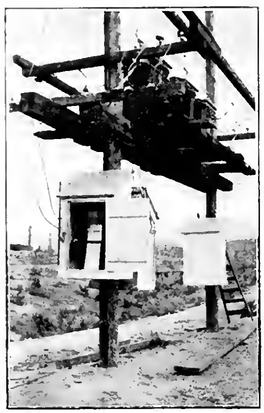
No.	Name of Article	Unit Weight	Total Weight	Unit Price	Total Price
15	40-ft. poles			$11.00	$165.00
17	Style D cross-arms	64	1088	.80	13.60
51	No. 9046 O B insulators	2	102	.15	8.16
17	No. 44 Locke insulators	1	17	.037	.63
6	No. 1060 Thomas strain insulators	4	24	1.33	7.98
68	1-in. leaded pins	1¾	85	.20	13.60
34	28-in. cross-arm braces	2	68	.11	3.74
60	½x3½ lag screws	3 oz.	11¼	.015	.90
12	⅝x14-in. bolts	1⅜	16½	.044	.53
6	⅝x16-in. bolts	1½	9	.048	.29
36	⅝-in. washers		2¼	.039	.09
4	anchor rods	14	56	.75	3.00
4	anchor slugs	50	200	.50	2.00
4	anchor slugs washers	2	8	.12	.48
4	goose egg strain insulators	1	4	.07	.28
200	ft. ⅜-in. guy wire		60	.0128	2.56
8	3-bolt clamps	1	8	.201	1.61
3	miles No. 4 H D copper wire	667.4	2002	.1513	302.90
1	mile No. 6 H D copper wire	420	420	.1513	63.55
100	ft. No. 6 S D copper wire		8	.152	1.22
6	small clevises	5	3	.043	.26
6	small thimbles		1	.023	.14
					$592.52
	Delivery of poles			.90	13.50
	Delivery of material		4613		18.00
	Surveying				9.00
	Labor				120.00
					$753.02



Detail of Standard 10,000 Volt Pole Top.

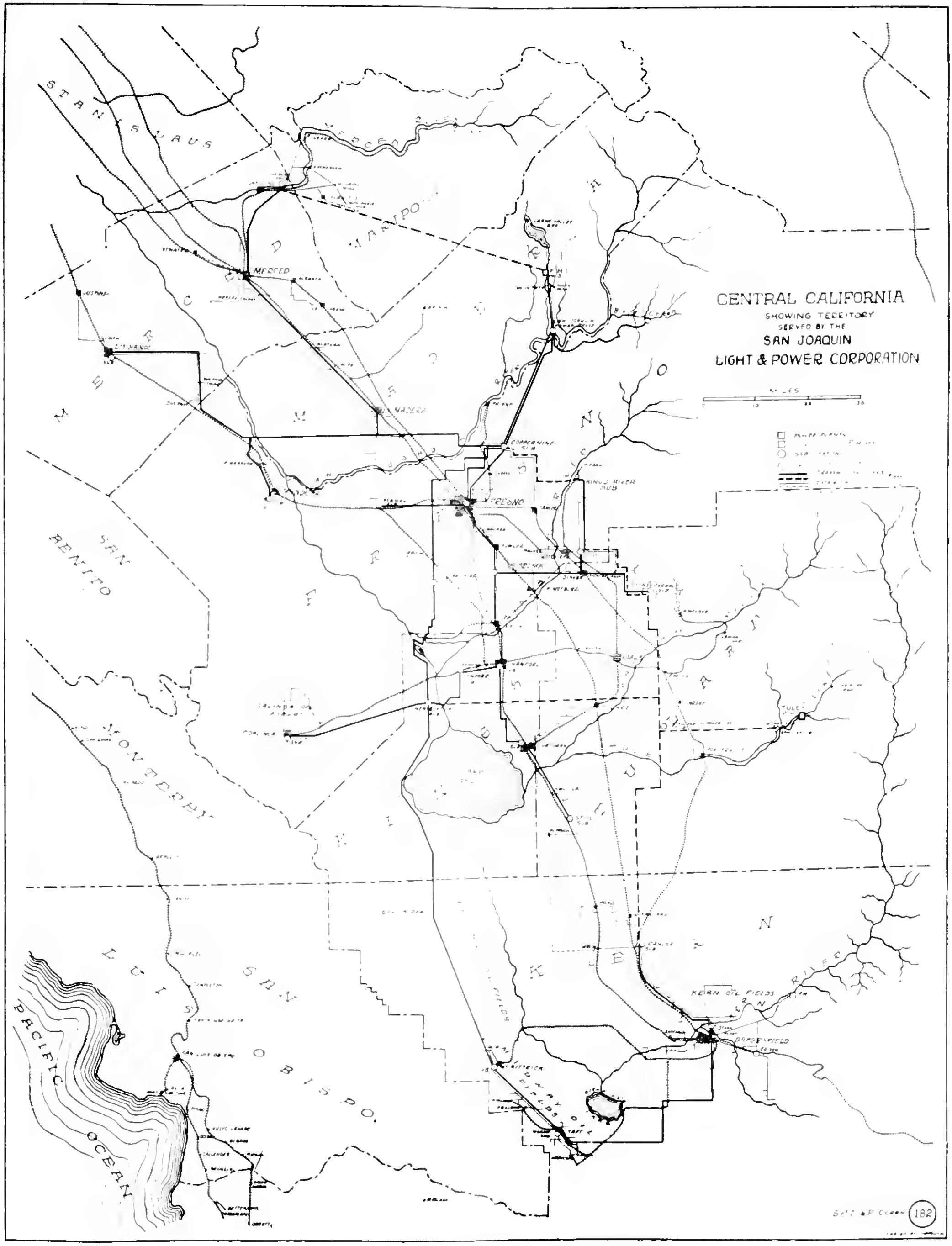
Telephone wires are carried on all lines on a two-pin arm under the power wires. The telephone wires are No. 8 hard-drawn copper and on the transmission lines are provided with taps running down the pole so that a patrolman may cut into the line at stated points. The telephone equipment is of a high class, built to order by the Kellogg Switchboard & Supply Company and are standard bridging sets of various resistance from 1600 to 2500 ohms, depending upon the location of the instrument. Insulated stands are provided at every telephone instrument. The telephones are mounted upon iron pipe frames and are in many cases equipped with a marble panel switchboard for operating upon the various lines.

In operating a telephone system in conjunction with high tension transmission, there is always more or less interference from the inductive effect of the high tension current. This is especially true if there is any unbalancing of the high tension circuits or accidental ground on the telephone circuit. This problem of inductive disturbance to telephone lines has been a bug-bear to all transmission companies, but this company has overcome the difficulty to a great extent in a novel manner.



Standard Transformer Mounting in Oil Fields Showing Meters.

At terminal points a standard 3 kw. 2000 volt lightning transformer is introduced between the telephone wires before leaving the last pole. The primary winding of the transformer is bridged across the telephone circuit. The center point of the winding is carried to ground. The secondary winding is left open. This grounding coil serves to remove all static

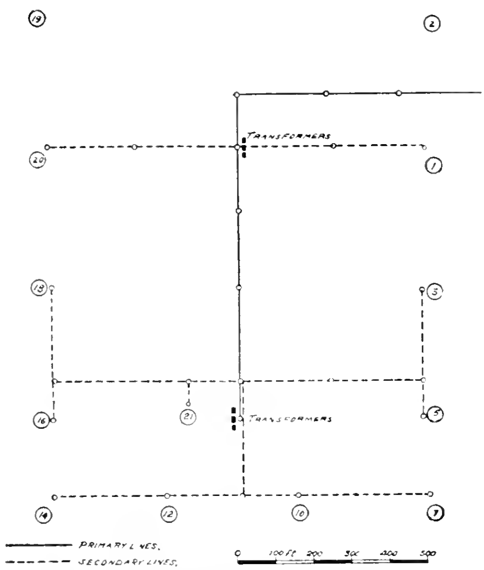


Territory Served by San Joaquin Light and Power Corporation.

potential from the telephone circuit without in any way interfering with the clearness of speech. Between these transformers and the telephone instrument are inserted fuses placed in porcelain tubes as an

Transformer Mounting for Commercial Service at Bakersfield.

added safety. This plan has worked admirably under all conditions for a number of years and seems to have satisfactorily solved the telephone difficulties for this system.



Layout for Lines and Transformers for Group of Oil Wells.

At all of the secondary substations where not over 30,000 volts is received, are placed General Electric, Wirts carbon resistance lightning arresters.

On the 60,000 volt circuits at principal switching points are placed General Electric outdoor type aluminum cell lightning arresters with horn discharge gaps.

A comprehensive system of distribution in the oil well sections is often made possible in the feeding of a group of wells from the fact that oil wells are generally placed with some regularity, about 50 ft. inside of the property lines, these in many cases being on quarter section lines. The accompanying cut shows half of a typical oil well distribution system to 22 or more wells.

In rural districts where the business of the company is both the supply of power for pumping water and for lighting and domestic purposes, if the district is sufficiently populous, a system of distributing lines along the road, which generally follow every section line, is used. It has been found that where service was introduced into a section, even against the prejudice of the inhabitants, it has been eagerly adopted not only for lighting, but for every conceivable domestic service which electric current can be put to; ironing, operating sewing machines, electric fans, washing machines, curling irons and even cooking.

Within the cities the conventional pole distribution is used for both 2400 volt 2 or 3-phase circuits and also series arc circuits. Where possible the lines are carried through alleys between the streets. This is particularly the case in Bakersfield, and here 60 ft. poles are used in the business section of the city. A standard type of transformer mounting is employed. The 2400 volt lines are carried on an arm at the top

Underground Arc-circuit Leads from Substation.

of the pole. About half way down the pole are the arms carrying the transformers and the fuse blocks are mounted on a separate arm below the transformers. The leads from the lines are brought down to the fuse blocks and then carried back to the transformers. This enables a trouble man to open the

fuse blocks and insert new fuses without danger of coming near primary wires.

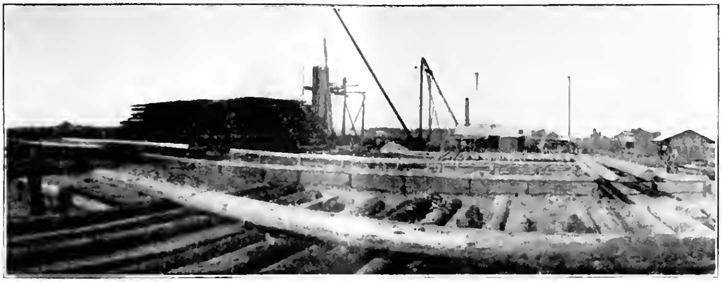
Series arc systems are invariably used with 6.6 ampere alternating current. There has recently been installed in Bakersfield a new street lighting system, using magnetite luminous arc lamps in series on direct current. The General Electric type M.S. regulator with a mercury arc rectifier, the primary voltage 2200 and rectified voltage 4500 with current of 4 amp., is used at the substation for control of this circuit. Arc circuits are brought out of the substations underground in lead-covered cable and carried to the top of the first pole, standard outlet bushings being used at the top of the pole.

Pole Treating Plant.

During the past years of operation, one of the most serious of the depreciation charges is for the replacement or repair of decaying pole butts. In 1908 a systematic study of this subject was begun with the idea of eventually correcting or preventing the trouble if possible. The poles in use were native redwood, cedar and yellow pine and Washington fir. During this year a line 30 miles long of native yellow pine poles was set after being thoroughly seasoned. Part of the poles were given a brush treatment of carbolineum and with creosote, the remainder received an open tank treatment of creosote, zinc chloride or crude oil. Stubs of untreated timber were set at intervals along the line for the purpose of comparative observation. In June, 1910, after a period of 27 months the line was inspected with the result that the untreated stubs were found to be completely rotted. The brush treated were found to be in a greater or less condition of decay, those treated with crude oil being in somewhat better condition than those given the carbolineum or creosote coat. About one-quarter of the poles given the zinc chloride treatment showed signs of decay while 50 per cent of the entire line which received the open tank creosote treatment were in sound condition.

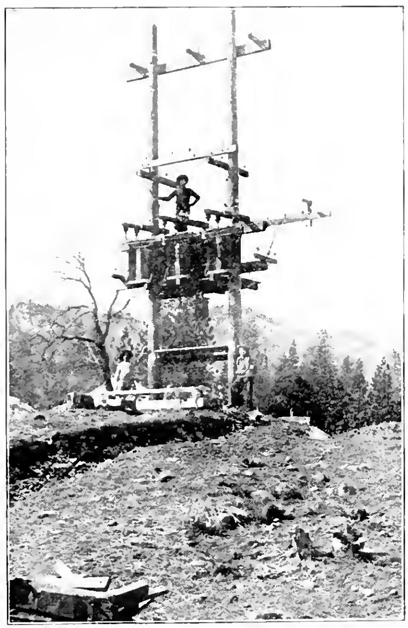
On the results of these tests an open tank creosote treating plant was erected at Fresno in 1911 and all of the poles now used on the system undergo this treatment, but for the butts only.

The plant covers about four acres adjacent to the railroad at the outskirts of the city and comprises a yard for storage of both treated and untreated poles. Poles to be treated are raised with a derrick operated through a double drum hoist by a 15 h.p. Western Electric induction motor. A 50 h.p. tubular boiler furnishes steam for heating the creosote bath. The treating plant consists of two square steel tanks placed at either end of a concrete trough, these are connected by a series of pipes and valves and supplied from large steel storage tanks placed in the rear. The pole which



Pole Treating Plant at Fresno.

must be dry is lowered into the tank containing hot creosote. This for Washington fir is heated to 212 degrees F. and the pole remains in this bath for four hours. It is then placed in cold oil for an additional

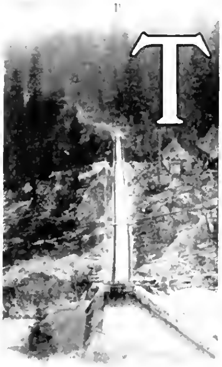


10,000 Volt Transformer Mounting.

period of three hours and the resulting penetration is about three quarters of an inch. With yellow pine the penetration is greater, in some cases extending almost to the center of the pole.

Sierra Nevada Mountain Summit.

Hydraulic Development and Power Plants.



Waste Weir No. 3 Canal.

THE water supply for the system, as operated at present, is derived from the north fork of the San Joaquin River. This supply comes from the water sheds of two tributaries to the north fork, the north and south. In 1909 it was decided to erect an immense dam at the site of the then existing dam in Crane Valley, this valley being part of the north fork of the stream. There were a number of serious problems to overcome in the construction of so large a dam and the entire matter, together with the reconstruction of the old canal system and of the No. 1 power plant, was placed in the hands of J. G. White & Company of New York.

As completed, this dam has a total length on the top of 1860 ft. The height above the lowest point of the canyon is 150 ft. the crest width of the earth fill section is 30 ft. and of the rock fill section 15 ft. The corewall of 1 to 2½ to 5 concrete extends throughout the length of the dam at its center. On the up-stream side of this corewall the dam is a hydraulic earth fill. On the down stream side it is a rock fill construction.

In building the corewall the native granite was thoroughly exposed and a trench was made 10 ft. deep. The concrete was built into this trench and the wall gradually tapered until a width of 2 ft. was obtained at the crest. The batter on the down stream side is 1:50 and on the other side 1:75. The corewall is reinforced with 1 in. plain square bars at the bottom and these decrease in size until at the top the bars are ⅝ in. Great care was taken that the base of this wall should form an absolutely water tight joint with the native rock.

In building the hydraulic fill on the up stream side earth suitable for this work was found near the dam. This material consists of coarse disintegrated granite

Crane Valley Lake and Dam.

with red clay and adobe, which, when mixed, form a very solid embankment. The impervious clay material was carefully placed next the corewall while the coarser granite material was placed farther out from the wall.

Conduit No. 3 Line.

Water for hydraulic purposes was brought from a point about 6 miles away through ditch and flume and was delivered to the nozzles of the hydraulic giants under a pressure of 150 lb.

A large quarry was developed at the eastern extremity of the dam and rock was transported on trestles from which it was dumped in place in front of the corewall. Much of the rock was carefully placed by hand so that a compact fill was obtained. In proceeding with this work it was found possible, using two shifts, to deposit 19,000 cu. yd. in one month.

The configuration of the ground surface was such that it was not necessary to place a spillway in the dam proper. This spillway has been placed in an adjoining canyon east of the dam. The sill of the spillway is at an elevation 8 ft. below the high water level of the reservoir. The spillway has a length of 70 ft. between the end abutments and there is a pier in the center which supports the heavy timber framework of the structure. There are 12 gates in which are placed 3 in. planks to regulate the height of the spillway. These gates are 6 ft. wide and are constructed to hold the water level 9 ft. above the sill if necessary. The waste-way is cut out of solid rock but has a concrete floor at the sill.

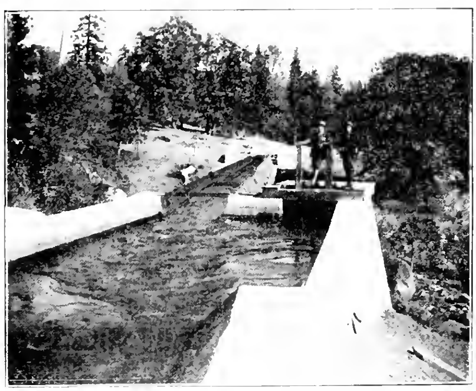
The reservoir formed by this dam is about 5 miles long. It contains 51,000 acre ft. and catches the run-off from 52 square miles, adjoining the north fork, and 26 square miles of the south fork. The reservoir area itself is 1200 acres.

During the construction of this reservoir there was cleared off 3,500,000 board ft. of lumber. Part of this was used in construction work. The remainder was shipped out in the returning freight wagons.

For controlling the outlet of water into the canal system a concrete tower has been erected in the reservoir, outside of the upper toe of the dam. This tower opens into a horizontal tunnel 722 ft. long, which is carried through the rock under the dam and into a concrete basin below the dam, on one side of which is contained an Ogee overflow wier. The gates allowing the flow from the reservoir into the controlling tower are operated through bevel gears placed on the top of the tower structure. These gates are placed at different heights, so that by proper manipulation, water may enter the tower from the surface only, at any elevation of the reservoir level.

Storage water from the reservoir enters the conduit system, which consists of a series of canals, tunnels and flume trestles, covering a distance of 4.22 miles, and is delivered into the regulating reservoir of No. 3 power house. The canals are in earth and have a trapezoidal section, the sloping sides being 1 to 1, the width of the bottom for part of the distance being 5 ft. with a grade of .15 ft. per 100 ft. and the remainder 6 ft. with a grade of .1 ft. per 100 ft. The depth of the excavation is 3½ ft. and the canal is given a 3 in. lining of concrete. The tunnels, four in number, are 5 ft. wide, 6 ft. high, with a semi-circular roof and are concrete lined. They are built on a grade of .3 ft. per 100 ft. There are 13 semi-circular steel flumes 6 ft. in diameter, which are given the same grade as the tunnels. These flumes are somewhat novel in construction, being of ⅛ in. riveted sheet steel and are supported on timber cradles and bolsters which in turn are carried by standard 4 pile trestle bents. Expansion and contraction are provided for by an unriveted slip joint. This joint is bridged on the outside with a strap of heavy canvas which is held in place by a steel strip at either end. This homely device has proven economical and efficient. The capacity of this conduit line is 100 cu. ft. per sec. The tunnels and trestles comprise 27 per cent of the distance between the dam and No. 3 regulating reservoir.

After being discharged from power house No. 3 the flow is allowed to pass down the canyon of the north fork to a point near the junction of that stream and the south fork, where a small diversion wier of concrete serves to form a pond from which the No. 1 conduit system is supplied.

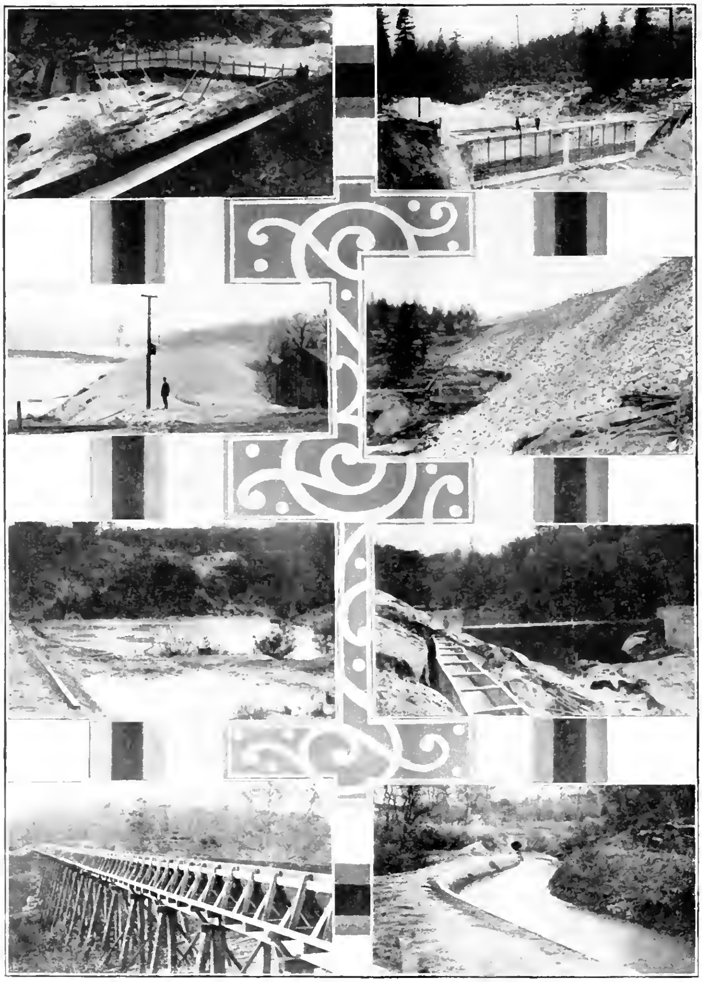


Metal Flume and Spillway No. 3 Line.

In this system there are 16 tunnels, having an aggregate length of 10775 ft. These tunnels are lined with concrete, 5 ft. wide and 6 ft. high, the top being semi-circular. There is 12,300 ft. of canal in earth and

715.5 ft. of concrete flume, at points where it would be difficult to maintain an earth canal.

Where canyons are crossed the semi-circular riveted steel flume mounted on timber cradles and conventional trestle construction are used. This canal should be of particular interest to California engineers as a departure in the practice of building canals as ordinarily understood on the Pacific Coast. It was found that to maintain a canal in the natural material, which is a disintegrated granite, was a more or less uncertain matter, as the outer walls of the canal were not only unstable, but were frequently attacked by burrowing rodents. After considering the problem of a proper construction thoroughly and the absolute necessity of maintaining the flow during reconstruction, it was decided to build a corewall in the outer bank of the canal. Accordingly a trench 2 ft. wide was dug in this bank and carried down to about 1 ft. below the bottom of the canal. Wooden forms were used in building the corewall and were placed in the trench, being held by the earth. The bottom of the corewall was allowed to spread out but the wall itself has a thickness of 6 in. and is carried well above the berm of the canal. This wall is reinforced with 3 in. x 12 in. mesh No. 6.10 gauge Clinton woven wire cloth 7 ft. wide.



Diverson Dam for No. 1 Conduit.
West End Crane Valley Dam.
Settling Basin No. 1 Conduit.
Trestle and Steel Flume.

Spillway Crane Valley Dam.
Diverting Dam and Concrete Flume.
Downstream Face Crane Valley Dam.
No. 1 Conduit.

There are two points where the canal is carried into gulches which by cross embankments, form small settling reservoirs of about one-third acre each. The embankment was constructed as a submerged rock-filled crib, the face being tightly sheeted and conventional corewall brought up above the ground surface.

In the south fork of this branch is a concrete diverting dam from which the water is carried into

Tunnel Flume and Canal in No. 3 Conduit

one of the settling basins already mentioned. This dam has a length of 110 ft. and a height of 20 ft. It has a vertical wall on the down stream side and a slanting wall on the up-stream side. At the west end of this dam is a single outlet gate 6 ft. wide and from this outlet a concrete flume is carried along the side hill to deliver the flow into the setling basin. This concrete flume is 5 ft. wide, and 5 ft. deep. The side walls are 6 in. thick and are reinforced like the canal corewall. The bottom is laid directly upon the prepared rock surface.

In the reconstruction of this line tunnels were employed wherever possible to shorten the line.

The canal is carried to the end or spur of the

Forebay Reservoir at Power House No. 3.

mountain, which divides the north fork from the main San Joaquin River, and delivers its flow into an 8-acre forebay reservoir constructed at a most convenient point for power development. It is oblong in shape and was formed by throwing up a simple and inexpensive earth embankment along one side. It has a capacity of 35 acre. ft. The location of this reservoir is not only unusually convenient, but is picturesque in the extreme, and a remarkable view of the surrounding canyons and mountains of the San Joaquin River and its branches may be obtained from this point.

A fall of — ft. from a diversion in the south fork to the Crane Valley reservoir, and the drop between Power House No. 3 and the intake of the second canal of — ft. form the sites for two new power installations to be developed in the near future.

No. 3 Power Plant, which at the present time is the highest in the system, is supplied through a tunnel from the regulating reservoir at an elevation of about 20 ft. below the high-water level. In this tunnel is placed a taper pipe for a length of 20 ft. varying in diameter from 60 in. to 52 in. and 3/16 in. thickness. After passing through a gate valve the main pipe line 52 in. in diameter extends to the power house, a distance of 3,131 ft. The fall at this point is 401 ft. The pipe varies in thickness as follows: 1141 ft. of 3/16 in., 170 ft. of 7/32 in., 160 ft. of 1/4 in, 680 ft. of 5/16 in, 320 ft. of 3/8 in., 100 ft. of 1/2 in.

There are a number of spring relief valves provided. The pipe is buried at least 18 in. below the surface of the ground and is anchored at intervals in concrete abutments.

The feeder pipes to supply the water wheels are taken off the main pipe at right angles and pass below the floor of the building, terminating in deflecting needle nozzles.

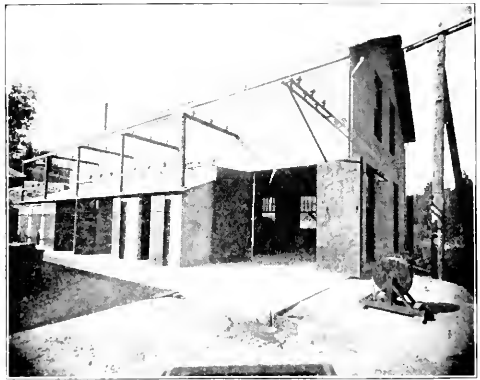
The plant is equipped with two main generating units. The generators are Bullock 1000 kw. 300 r.p.m. They generate 3-phase current at 550 volts. The armatures are Y connected with grounded neutrals. An unusual and somewhat unsatisfactory expedient is adopted with these machines in that the exciters are mounted on the generator shaft and stand between the main generator and one of the main bearings. The exciter is a 6-pole 125-volt d.c. generator. There are two overhung Doble tangential water wheels in sheet-steel housing, one at either end of the shaft. These are controlled by a Lombard type Q governor which in turn is operated by an oil pump belted to the generator shaft. The switch board contains 4 vertical panels and a 4-panel bench board and is equipped with Westinghouse and Wagner instruments. The 30,000-volt Kelman high-tension oil circuit breakers, of which there are three sets, are ope-

rated from levers mounted on the bench board. These high-tension circuit breakers are themselves mounted on steel brackets fastened to the rear wall of the building and the high-tension wires are mounted on insulators supported from steel brackets above the circuit breakers.

A 20-ton Maris traveling crane operates throughout the length of the building.

The building is of concrete 36 ft. wide and 65 ft. long. The walls are 14 in. thick with buttress columns which support a reinforced concrete crane rail integral with the walls.

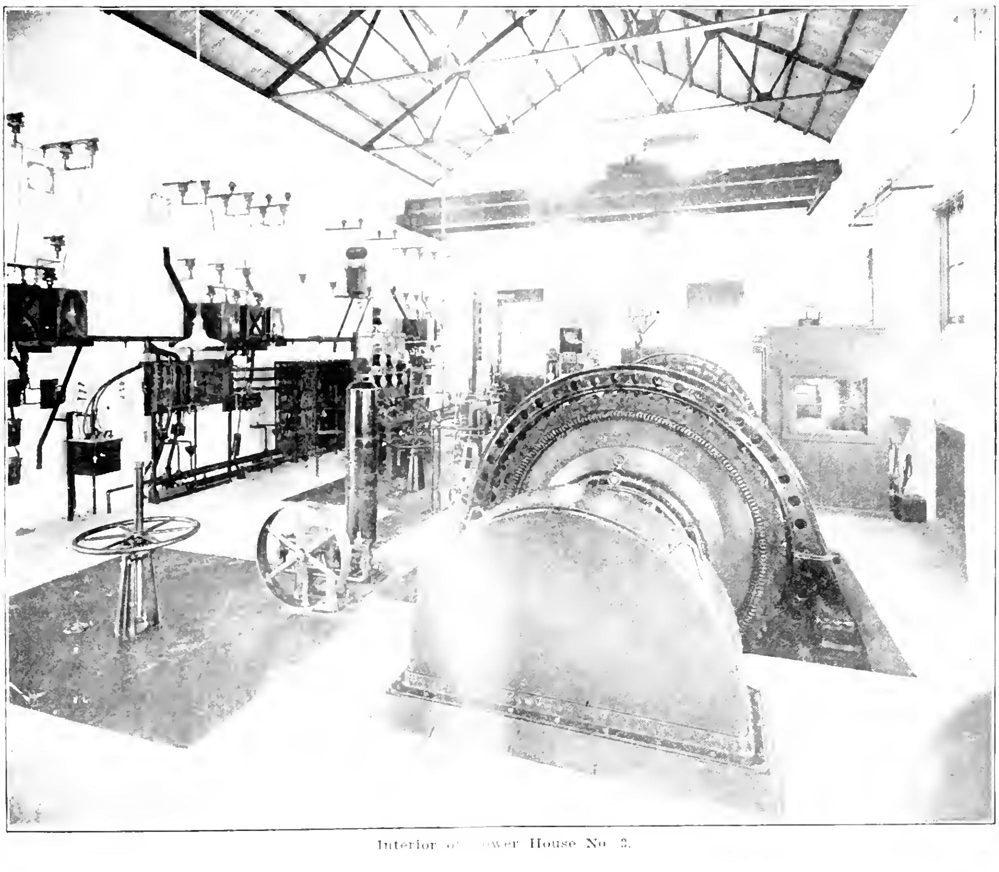
The roof is of corrugated iron supported on steel Fink trusses and steel purlins. The transformers, 7 in all, (1 being a spare) are contained in separate concrete compartments adjoining the rear wall of the building. These transformers are of the Bullock 350 k.v.a. type and are water cooled.



Exterior of Power House No. 3.

San Joaquin No. 1 Power House was placed in full operation in the summer of 1911 and replaced the original plant built in 1896 which was famous in its dau for the high head employed and as one of the history-making power plants during the development period of long-distance transmission. The old plant has been dismantled and the building is used as a storehouse. The famous pipe line of 18 years ago still remains, however, in apparently as good condition as when installed. A new 3000 kw. generating unit is to be installed in an addition to the power house and supplied by this pipe. This installation is to be used only on a 4 to 1½ hour peak of the load.

Water for the new plant is taken from the fore-

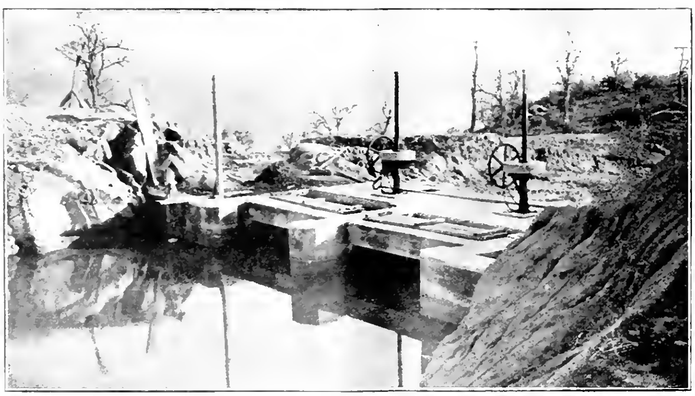


Interior of Power House No. 3.

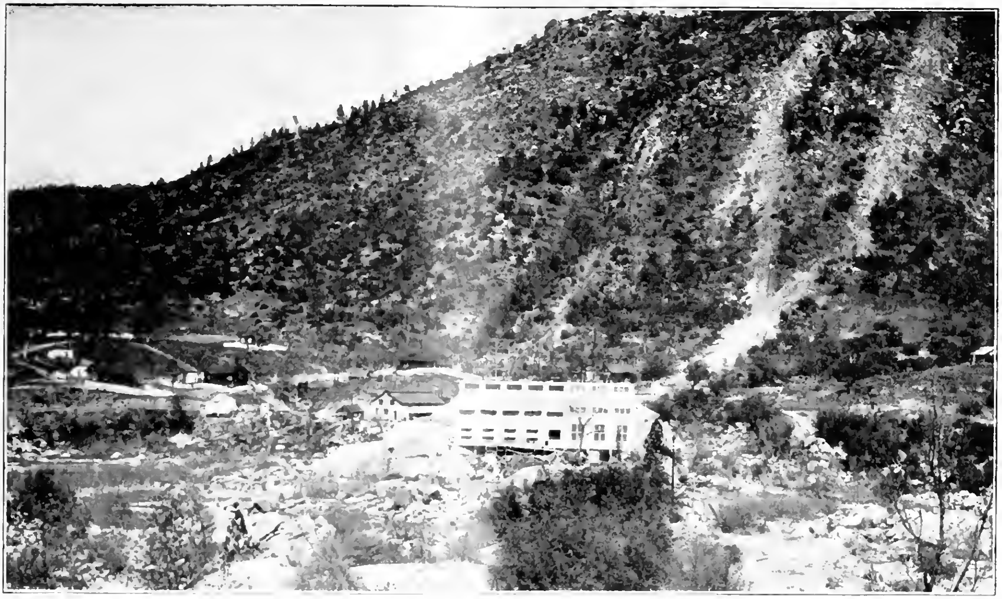
Forebay Reservoir Power House No. 1

bay reservoir at a point on its south side through a heavy concrete head works. This consists of a double forebay with hand operated screw-stem sluice gates and provided with fine and coarse screens. The two pipe lines lead from this forebay and immediately take their course, which is somewhat diverging, down the precipitous mountain side. The pipes are well buried throughout their length and are anchored at a number of suitable points with heavy concrete piers placed in the bell holes excavated for riveting the pipe seams. The steepness of the mountain side and its rocky and generally rough character made the installation of these pipes a difficult feat. In addition it was necessary to do the work under the hot sun during the summer months when the men were constantly menaced by rattlesnakes which persisted in falling into the pipe trenches and necessitated the entire attention of one man to kill them and warn those working.

The maximum grade on the mountain side is 77 per cent. The pipes were laid beginning at the bottom and were filled with water as the work proceeded in order that the temperature of the metal might be kept as nearly uniform as possible. It was furnished in lengths of 30 ft., the maximum weight of sections being 10,000 lb. A tramway was built to assist in the delivery of pipe to the trench. Both pipes have a diameter of 34 in. at the bottom and a thickness of ¾ in. and are lap welded. This diameter increases and the thickness decreases as the pipe proceeds up the hill until at the top the former is 44 in. and the latter ¼ in., the greater part of the pipe being lap riveted. Near the top a Venturi meter equipped with



Penstock Intake and Gates for No. 1 Power House.



Power House No. 1 Showing Pipe Lines and Original Installation.

an automatic recording device was installed in one of the pipe lines. The pipes, as they approach the power house, are deeply buried and anchored in solid concrete. They enter the building below the floor line and branch, each branch going to one of the four main water wheels.

The older pipe line is 24 in. in diameter and varies in thickness from No. 12 B. W. G. at the top to 20 in. at the power house, ⅝ in. thick and 4,077 ft. long, including a 30 in. diameter receiver.

Pipe connections to operate the two water driven exciter sets are taken from each pipe line. These 10-in. extra heavy steel pipe connections are brought first to the ground surface. A system of 4 cross gates and fittings makes it possible to feed either or both exciters from either or both pipe lines. A tap is taken out to supply a tank from which water for cooling the transformers is taken. This tap contains an automatic valve which keeps the tank full of water at all times.

The power house building is 148 ft. long and 71 ft. 6 in. wide. It is a heavy steel frame structure covered with two layers of Hyrib expanded metal and Portland cement plaster 1½ in. thick. This method of building a double wall insures a dead air space and tends to lower the summer temperature, a necessary feature in this locality.

The steel frame consists of three lines of columns, two of them being along the front and rear of the building, the third down the center. Between the front and center line is the main generating space. Between the center line and the rear is the space occupied by transformers, switch board and ample storerooms on the main floor and on the second floor by the high-tension switching gallery of which there are two sections. An all electrically driven traveling crane operates the length of the generating bay.

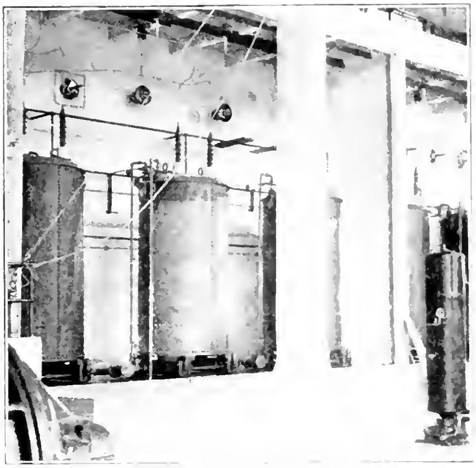
There are four main generating units. The generators are General Electric 4,000 k.v.a., 2,300 volt, 3-phase, and operate at 400 r.p.m. The water wheel is a single overhung Doble runner enclosed in a cast-iron housing and is equipped with two needle nozzles. The upper or main nozzle is operated by a type Q Lombard governor. The lower nozzle is a by-pass and opens when the main nozzle closes, thus removing the water from the wheel without shock to the pipe lines. The automatic mechanism gradually closes the by-pass needle so that water may be conserved when it is not in use on the wheel.

There are three exciter sets, the generator in each case being a General Electric type M.P. 6 pole, 100 kw., 900 r.p.m., 250 v. d.c. machine. One set is driven by a Doble overhung water wheel at one end of the generator shaft and a 150 h.p., General Electric type I induction motor is at the other end. The second exciter set is similar but has no induction motor. The third exciter set is similar to the first described, having the induction motor, but no water wheel.

A three-crank oil pump driven by a 1½ h.p. General Electric induction motor circulates oil to the transformers. There is also provided one 2-cylinder air compressor driven by a 4 h.p. General Electric induction motor. The transformers occupy four compartments open to the main bay but enclosed in concrete walls on the other three sides. In each compartment are three 1500 k.v.a. General Electric transformers mounted on 4 wheel steel trucks which in turn rest on rails in the concrete floor and permit the transformer to be moved out into the main bay so that it may come under the traveling crane. The transformers are wound for a star connection of 69,450 volts, are water cooled and the tanks are connected through a system of piping to a concrete oil sump-tank which is placed

below and outside of the building. Connection is also made with a steel tank which holds enough oil for one transformer placed below the main station floor.

The switch board supplied by the General Electric Company is of black slate in 17 vertical panels, which



Bank of Transformers

control four generators, two exciters, 1 Tirrill automatic regulator, four transformer banks and the remainder for high-tension lines. Indicating and graphic recording instruments are provided in accordance with the most modern practice.

The 2,300 volt generator and transformer switches are placed in concrete cells directly in the rear of the switch board so that the connection between the operating handles on the switch board and the switches is entirely mechanical.

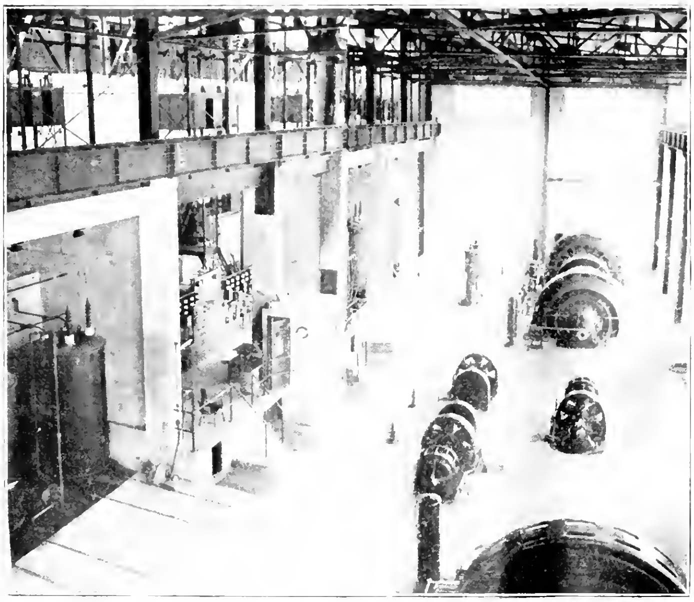
The high tension circuit breakers were supplied by the Kelman Manufacturing Company and are arranged in two rows. Between these rows are two parallel fireproof walls and between these walls the high tension leads from the transformers are brought up and then branched to the circuit breakers on either side. The space between these walls also contains series and shunt transformers.

There are two sets of high tension bus lines, each set being divided at its center point where a Kelman oil circuit breaker is placed. There are altogether 18 sets of high tension circuit breakers, each set being equipped with knife blade disconnecting switches. There is provision for six outgoing transmission lines, although but four are at present installed.

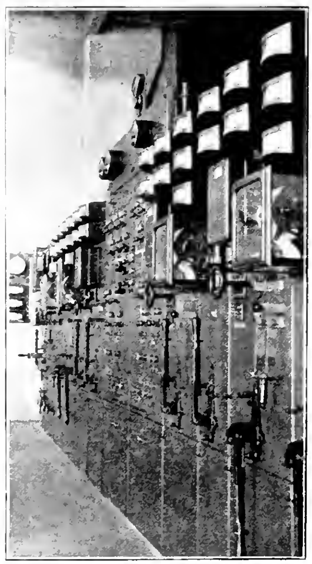
The method adopted by this company in carrying 60,000 volt lines from the building is unique. A Locke wall insulator mounted in a concrete slab is placed on an angle to an opening in the building wall of about 45 degrees. Above this is a lean-to roof, the whole being structurally connected. All of the high tension wiring, switches and insulators are mounted on structural steel framework.

This building contains no wood or inflammable structural material of any sort, the window frames being of steel and the windows of wire glass. This power house has a total capacity of 20,000 h.p. The hydraulic head is 1420 ft. The discharge from the plant is directly into the San Joaquin River. The lines leading from the plant are provided with General Electric outdoor type aluminum cell lightning arresters, equipped with horn gaps.

Kern Canyon Power Plant.—The Kern River emerges from the canyon through an opening in the sheer side of the mountain that appears as though it might have been cut by some gigantic ditching machine. It is V shaped and extremely rough, the pre-



Interior of Power House No. 1.



Main Switchboard.

23,000 Volt Generator Switches and Disconnectors.

cipitous mountain sides being strewn with jagged ledges and great granite boulders. About two miles above this mouth a granite ledge forms a natural dam across the river. On the north side and about 50 ft. back of this ledge is the opening into the tunnel which carries water to the power plant. This opening is covered by a grizzly of heavy iron bars, and within it is placed a sluice gate to shut off the flow, this tunnel opening being at all times submerged.

This plant is one of the first hydroelectric plants to be installed in California, and, while small, has had an interesting history. When first constructed, water was carried from the point of diversion along the face of the rocky cliff in a wooden flume. The high factor of depreciation and the danger of breaks with resulting interruptions in the operation of the plant made its abandonment advisable, to be replaced with a tunnel 8,500 ft. long, driven through the solid granite mountain. This tunnel is 8 ft. wide and 7 ft. high and has a gradient of 0.32 per cent. It is lined with concrete, and terminates at the head of the pipe line as did the old flume.

After leaving the tunnel the water passes through a 5½ ft. diameter hydraulic piston operated gate valve and thence into the pipe line. This pipe is not buried but rests on the surface of the ground, being anchored at a number of points with steel cables turned about the pipe and fastened into concrete piers. The pipe has a diameter of 66 in. and varies in thickness from ¼ in. at the top to ⅜ in. at the bottom and has a length, including the receiver, of 4,077 ft., and the total drop is 1,411 ft.

The power house is a frame structure at the river's edge just outside the canyon and contains three General Electric revolving field 450 kw., 3-phase generators driven at 257 r.p.m. through a flywheel coupling by Knight water wheels.

Water from the receiver is carried to the water wheels after passing a hydraulic operated gate valve. These valves are operated from a bench board near the main switch board, each by a brass handle and dial, as is also the gate at the top of the pipe line. Between the hydraulic gates and the water wheel are butterfly valves which are operated by a cast-iron hand wheel and column.

There are two exciters, the generators of each being General Electric 17.5 kw. operating at 1,100 r.p.m. One of these is driven by a Pelton triple runner water wheel, the other by a Knight single runner wheel.

Pipe Line and Kern River Power House.

The switch board has 8 panels, 3 for transformer circuits, 1 for exciters, 3 for generators, and 1 for voltage regulator.

There are nine General Electric transformers, six of them are old style air cooled 160 kw. capacity with a voltage ratio of 500 to 10,000. The remaining three are of the newer vertical type, also air cooled, and are of the same capacity and voltage ratio.

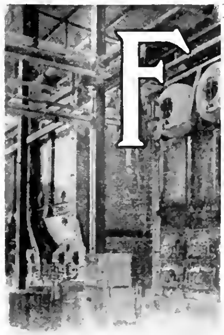
Intake Kern River Plant.

Two rotary blowers driven by water wheels furnish the air for cooling the transformers. A third blower furnishes air which is driven into the revolving armatures of the generators for cooling, there being seasons of the year when the temperature at this plant becomes excessive.

Kelman 60,000 Volt Switches in High Tension Gallery.

A two-circuit transmission line conveys the current to Bakersfield, where it is synchronized with the other 10,000 volt circuits in this district.

Steam Power Plants.

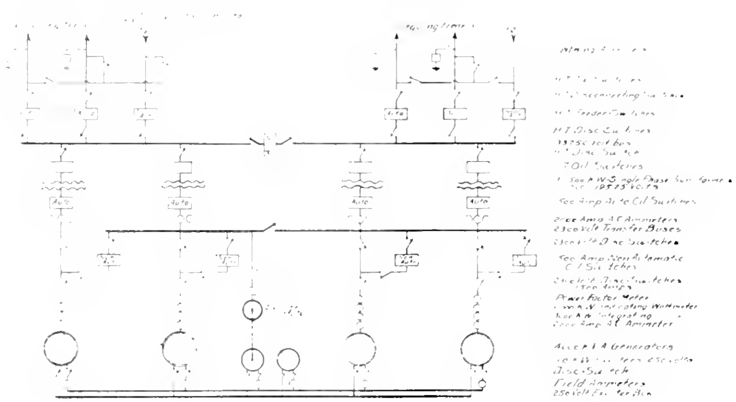


Boilers, Bakersfield Plant.

FRESNO Power Station—The steam power plant in the city of Fresno acts also as a substation for the distribution both of the local city system and for a number of outgoing branch circuits which cover a large territory. This station adjoins the tower of the water works. The power station is inclosed in a substantial brick building containing the entire equipment in use at this point.

The steam section consists of four Babcock & Wilcox boilers, two of them being of 200 h.p. each, the remaining two being each 300 h.p. The conventional accompaniment of Worthington feed pumps, one Hooper exhaust heater, one Worthington condenser placed in the basement of the building, and outside under the sidewalk a cement tank with a capacity for 620 bbl. of oil.

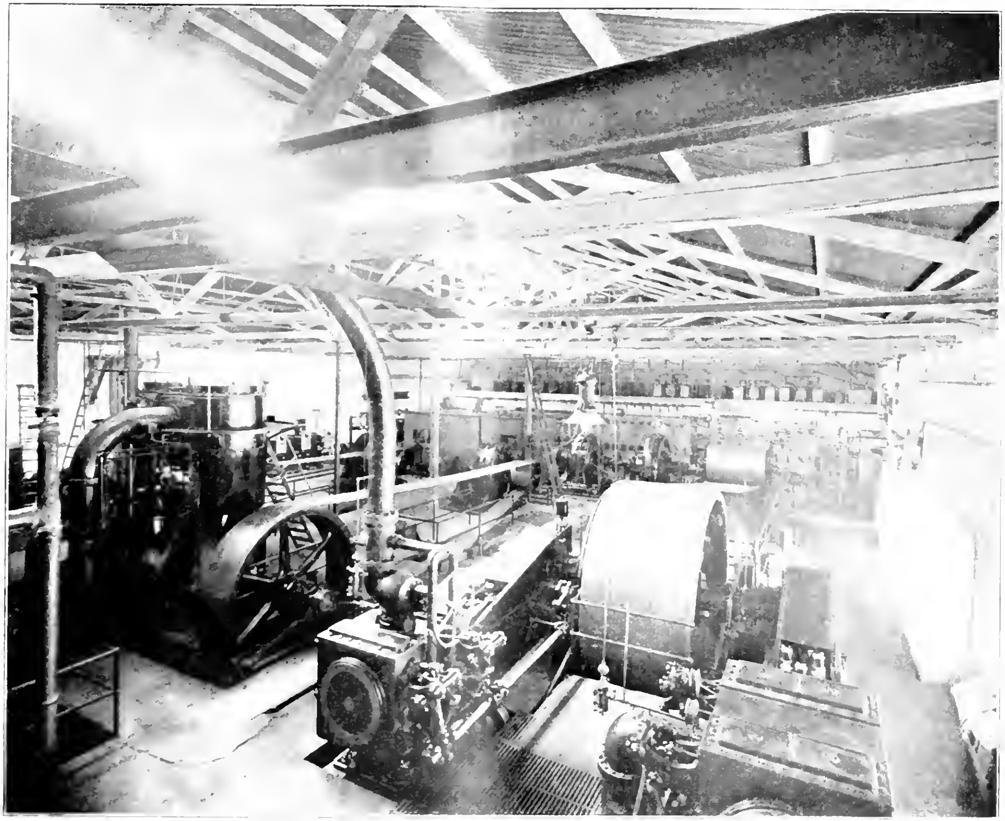
Held ready for immediate operation at all times is a cross compound grid. valve, MacIntosh and Seymour 750 h.p. engine. This engine is connected through a double 4 ft. belt to a pulley which forms a joint connection between two motor-generator sets. Thus, it is possible by manipulation of the clutches at either end of this pulley to drive the motor generators from the engine in case of failure of the supply of electricity from the transmission system. These motor generator sets consist on one side, of a Westinghouse 335 h.p.



Wiring Diagram San Joaquin No. 1 Power House.

It is proposed, in the near future to erect a low dam at the intake of this plant, enlarge the tunnel and pipe, sealing the junction between, thus carrying the pressure head from the reservoir level formed by the dam. A single 3,000 kw. generating unit is to be installed in a modern concrete fireproof structure.

synchronous motor on which is directly mounted a 6 kw. 6 pole exciter. This motor is connected through a flexible coupling to a General Electric 200 kw. 6 pole d.c. generator, the other end of the shaft being connected to the engine pulley through a jaw clutch operated by a hand wheel gear. Connected to the other



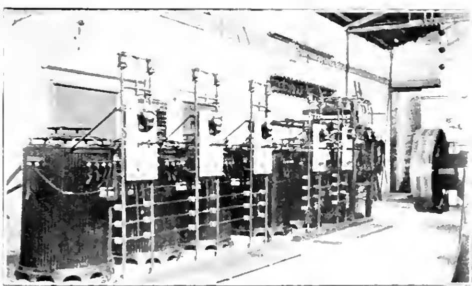
Int[illegible] Steam Plant.

end of the pulley through a sim[illegible] jaw clutch [illegible] motor generator set of a somewhat later type, ha[illegible] but two bearings. This set has a Westinghouse [illegible] h.p., 2,200 volt, synchronous motor. The generat[illegible] of the same make, of 200 kw. capacity. The ex[illegible] is mounted on the shaft as in the first instance. [illegible] speed of the set is 450 r.p.m.

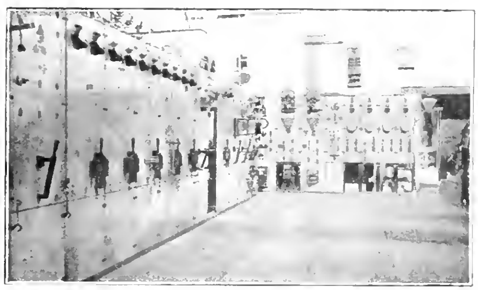
There has been recently installed an additi[illegible] Westinghouse motor generator set, the motor being 580 h.p., operating at 720 r.p.m. The generator [illegible] 400 kw., equipped with interpoles and a ball thr[illegible] bearing. This set is ordinarily used to carry the lo[illegible] street railway load. There is, for this set, a mo[illegible] generator and exciter unit, consisting of a Westinghouse 10 h.p. induction type, C.C.L. 220 volt motor, operating at 1,110 r.p.m. and driving a 6 kw. generator of the same make.

Ranged along one side of the building are five General Electric 50 light 6.6 amp. arc transformers for series arc circuits, together with their equipment of control panels.

The switch board is of blue Vermont marble consisting of 25 panels. These control the 3 outgoing 30,000 volt circuits, 2 of them supplying Selma and Reedley and Dinuba; the third, Hanford, Corcoran and Coalinga. There are 8, 2,300 volt circuits for

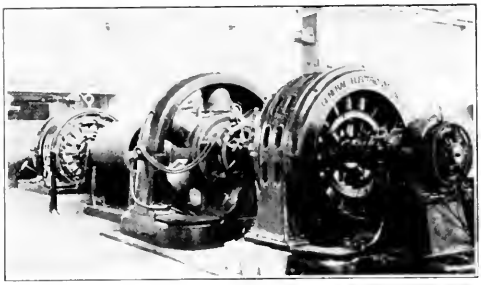


Arc Transformers at Fresno Plant.



Switchboard at Fresno Plant

local distribution, and 3, 10,000 volt circuits for suburban distribution. The remainder of the panels control generators, motors, water works circuits and railroad circuits.



Motor Generators at Fresno Plant.

At the rear of the switch board placed in brick compartments which open only to the outside of the building, are four sets of Stanley water-cooled transformers, there being, with one exception, but two transformers to a set. They are T connected on the 30,000 volt side and are connected in open delta on the 2,300 volt side, and deliver both two and three phase current. The capacity of these transformers is 500 kw. There are in addition three General Electric air cooled transformers of 200 kw. capacity each. These are star connected on both primary and secondary sides and supply three phase current to the 10,000 volt suburban circuits.

The high tension switch gallery is a floor built over the transformer compartments and contains two lines of Kelman 30,000 volt oil circuit breakers, with a dividing wall between them, the entire gallery containing 15 sets of switches.

This station is the control point of the northern division of the system.

Bakersfield Steam Plant—This plant has but recently been placed in commission. It was built as an auxiliary emergency supply to the transmission system, and was placed at Bakersfield as the logical center of distribution for the Southern Division, and as the cheapest fuel depot. This plant is strictly modern throughout and represents the best practice for efficiency and stand-by service.

The building, like all the recent work of this company, is of massive steel frame construction covered with Hyrib expanded metal and finished with plaster concrete walls. It is in two main sections divided by a fireproof wall, one containing the boilers and fuel supply apparatus, the other the prime movers, auxiliaries, transformers, and the switching apparatus. The building is fireproof throughout. In the boiler section along either side are 4 boilers, both sides being similar and consisting of two Babcock & Wilcox boilers of 450 h.p. each, and two Sterling boilers of 500 h.p. each. Natural gas, piped from the near-by Kern River oil fields, is the fuel ordinarily used, although oil burning equipment is installed as a reserve. Fuel oil is drawn from the large steel tank placed in the yard near the power house.

The other section of the power house has three floors, more or less broken up to accommodate the apparatus contained thereon. The first, or ground floor, contains the engine and boiler auxiliaries,—two Harrisburg (Fleming) tandem compound engines direct connected to Byron Jackson circulating pumps, two Alberger dry vacuum pumps of size 10 x 18 x 18, three Worthington and one Epping-Carpenter feed pumps, and two Alberger surface condensers which are placed within the arch of the foundation under the main turbine generating units which are at the level of the second floor.

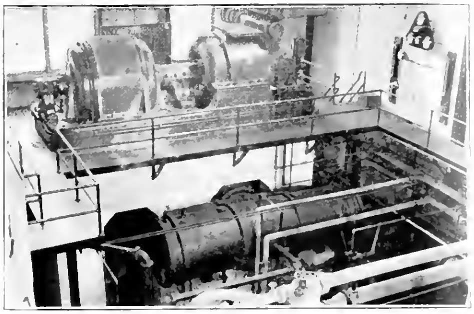
On either end of one side of this section are the two main transformer compartments. The first of these contains four (1 spare) General Electric 833 kw. water cooled transformers, whose primary voltage is 2,300. There are two secondary voltages of 10,000 and 66,000 with star connection. In the other transformer compartment are four Allis-Chalmers water-cooled transformers of the same voltage ratio as the others without the 10,000 volt windings. These have a capacity of 2,100 k.v.a. each.

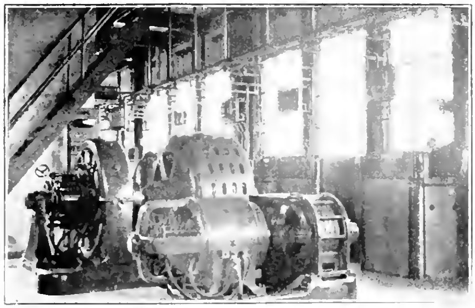
On the ground floor and arranged along the rear walls of the building between the transformers compartments are all of the 2,300 volt switch cells and switches. In this space are also two motor generator sets, consisting each of a General Electric type I 350 h.p., induction motor, direct connected with solid coupling to a 6 pole, interpole, 225 kw. d.c. generator. These machines supply current to the street railway system in Bakersfield and vicinity. There are also two General Electric motor generator exciter sets, the motor being of 60 h.p., 2,200 volts, induction type, the

30,000 Volt Outlets Fresno Plant.

generator being of 50 kw. There is also one steam exciter set having a 75 kw. generator driven by a Curtis non-condensing turbine and operating at 3,300 r.p.m.

The main generating units on the second floor level are two in number, the first being a General


One of Turbo-Generators.

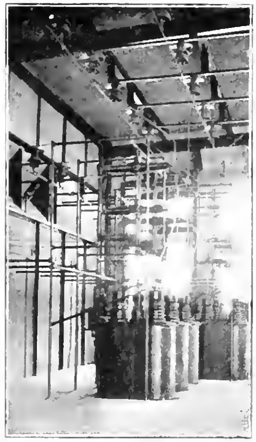

Motor Generators, Exciters and 2300 Volt Switches.

Electric horizontal set, having a capacity of 2,500 k.w. and operating 1,200 r.p.m. The second unit, built by the Allis-Chalmers Co., has a capacity of 5,000 kw.

On the second floor gallery at its center is placed the main switch board. This was built by the General


Wire Rack, Bakersfield Steam Plant.

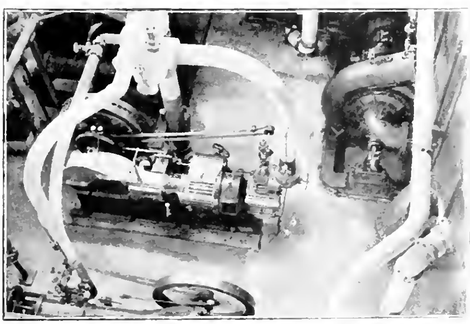

Main Switchboard.

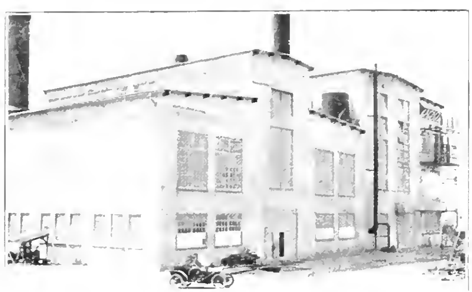

High Tension Gallery and Switches.

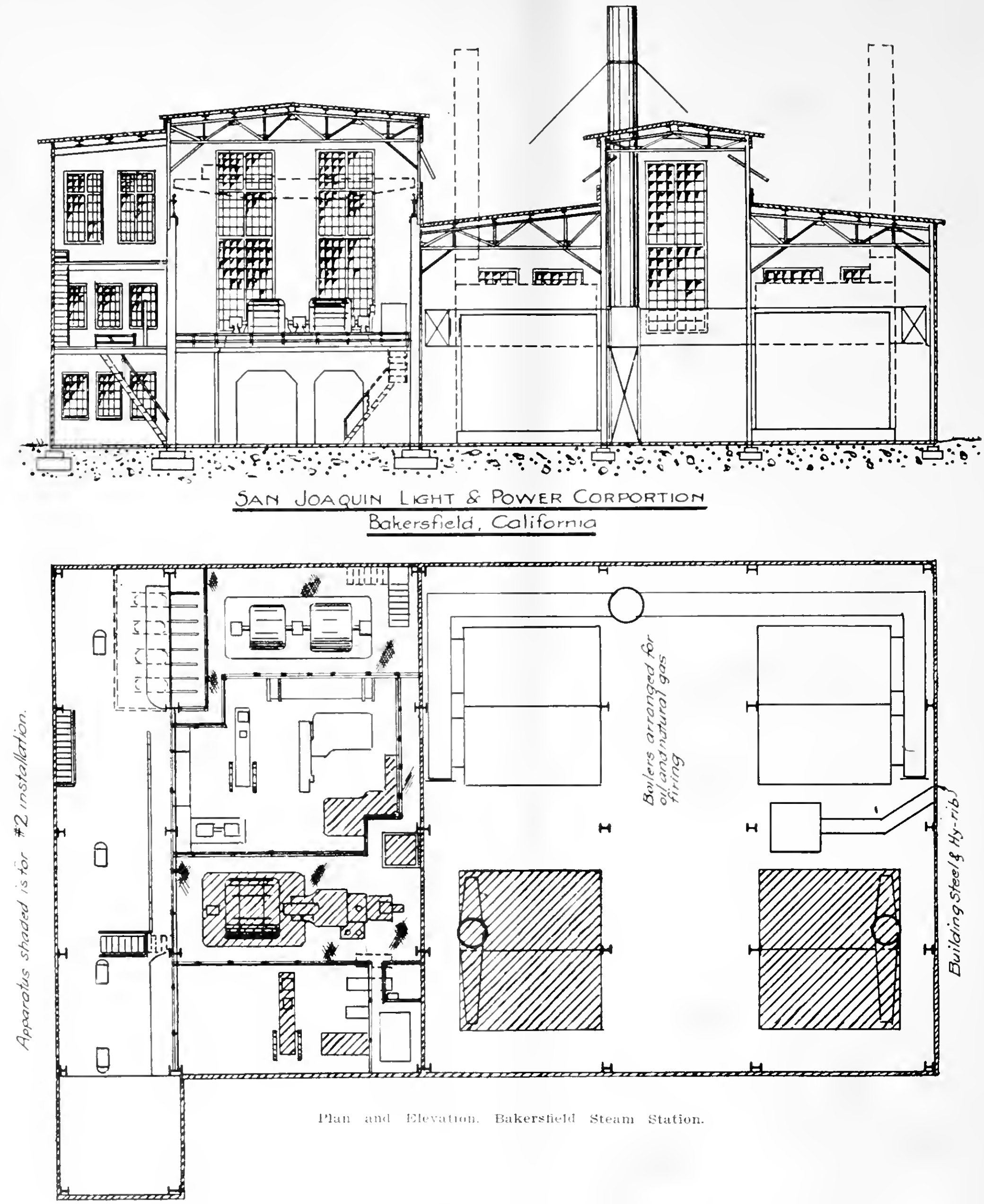
Electric Co., is of black slate, and consists of 23 panels. The panels are equipped in accordance with the most modern practice, with horizontal type instruments and remote control for all of the generating and outgoing circuits. On the iron pipe frame at the back of the switch board are mounted integrating and graphic recording wattmeters for each circuit.

Placed on the gallery at the rear of the switch board are all of the 10,000 volt General Electric oil circuit breakers, in such order as to cause the least possible confusion in the minds of the operators.

On the third floor or gallery are placed four sets of General Electric K-10 solenoid operated 60,000 volt oil circuit breakers. Two of these sets are on the two sets of transformers and two on the two outgoing transmission lines. The 60,000 volt leads of 1 in. cop-


Looking Down at Steam Auxilliaries.


Bakersfield Steam Generating Station.



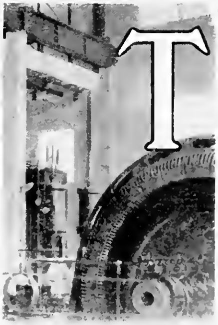
Plan and Elevation. Bakersfield Steam Station.

per tubing are brought up to the level of this floor through 3 ft. square ducts, and led directly to the oil circuit breakers. The connection between these and the outgoing line circuit breakers is made through a bus line and the customary intervening disconnecting switches. All of the high tension wiring is mounted on standard triple petticoat insulators on structural steel framework.

At the rear of the building is a structural steel rack which covers the entire side. This carries at their proper level all of the circuits which enter or leave the building.

Near the building and connected to the 60,000 volt outgoing circuits are General Electric aluminum cell lightning arresters, for though lightning is of rare occurrence, these are deemed a necessary precaution.

Substations.



TO maintain exact standards in the design of the various essential parts of any large transmission system is difficult, particularly in one of the magnitude and diversification in the distribution of this system. Especially is this true of the sub-stations, some of which have been in operation a number of years, and which were intended for smaller loads and more primitive transmission conditions than exist at present. Two new types, however, modern in every respect and providing for present and future needs, have been developed and are sufficiently characteristic as to deserve careful study as to its efficiency and comparatively low cost and safety.

In general the substations may be classed in three types. One contains transformers receiving three phase current at a potential of 30,000 volts and delivering from their secondary windings a potential of 10,000 volts for feeder circuits covering a distribution territory of not greater than 16 miles from the station, these stations requiring no regular attendant. The other are of the newer order and receive three phase current from the main transmission lines at a potential of 60,000 volts and distribute to main 30,000 volt feeders or to district 10,000 volt feeders. These stations are constantly attended by an operator who lives close by. The third type is novel and, in fact, quite radical, there being no enclosing building.

In the towns and cities, where distribution voltages of 2,400 or 4,000 volts are maintained, the substations are generally in buildings acquired in the absorption of local companies, or in connection with other enterprises maintained by the company, as gas or water works.

Stone Corral Substation.

Of the newer type of substation there are four. The first, known as the "Copper Mine Sub," is situated where the foothills meet the valley, 16 miles northeast of Fresno. This is on the direct line of transmission between the power plants and that city, but acts as a distributing hub for the entire system, from its more northerly source of power. Two entering transmission lines deliver their current directly from the No. 1 power house, these lines being constructed for an eventual operation at 60,000 volts. Distributing from this station is a single 60,000 volt line, the main "west side" transmission which connects the northern and southern divisions and operates through to Bakersfield, passing through the "west side" oil fields. There are four 30,000 volt feeders, one for the Merced, Madera, Mendota and Los Banos districts, two to the city of Fresno, and one skirting the foothills to the south to the Santa Fe stone crusher on the Kings River and the intermediate country.

Madera Substation and Pumping Plant.

The station at Henrietta is midway on the west side line between Copper Mine Sub., and Bakersfield, just northwest of Lake Tulare. From this point diverge two 30,000 volt circuits, one going to Coalinga and one in the opposite direction to Lemoore. This, like the Copper Mine Sub., acts also as a switching station.

The stations at McKittrick and Taft in the Midway oil fields are identical in appearance and equipment, the former having two 10,000 volt local distribution circuits, the latter two 10,000 volt and 30,000 volt outgoing circuits.

A description of the substation at Henrietta will substantially cover the others.

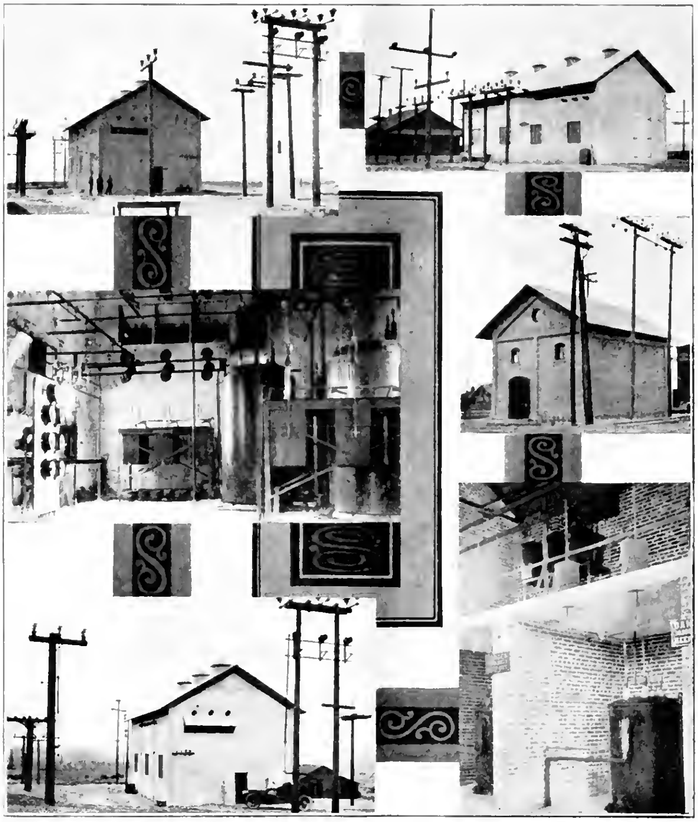
This substation is a steel frame building 30 ft. wide and 60 ft. long. There are four Fink trusses of steel which carry steel I beam purlins. The walls are of Hyrib expanded metal in two layers, one on the outside and the other on the inside of the steel columns. On this reinforcement is placed cement plaster which gives an outside and inside solid concrete wall, each $1\frac{1}{2}$ in. thick. The roof is of the same construction, being plastered on both sides of the Hyrib, but having on the upper side a layer of asbestos board. Under the eaves are openings for the free circulation of air and in the ridge of the roof are three large galvanized iron ventilators, all of these openings being covered with No. $\frac{1}{2}$ in. mesh woven wire screen to keep out birds and large insects. High temperatures are experienced part of the year and the rapid circulation of air is essential, especially in view of the use of air cooled transformer cases.

The 60,000 volt line is led into the building through the standard type of inclined wall bushing adopted by the company, through disconnecting switches mounted on standard insulators supported on an angle steel frame, to the Kelman circuit-breakers and thence to a bus line which extends the length of the building and which, passing through a switch equipment, similar to the one just described but reversed in order, to the continuation of the transmission.

Taps are taken from the bus line to feed the transformers, the current first passing through a disconnecting switch set and Kelman circuit-breakers, all mounted on a steel frame. The high tension wiring is all of $\frac{7}{8}$ in. copper tube.

There are four Allis-Chalmers 500 k.v.a. lowering transformers. These have voltage ratios of 41,000/17,000, being Y connected on both sides for circuits of 60,000 and 30,000 volts respectively. In the stations having 10,000 volt distribution circuits the low tension windings deliver 6,600 volts which are Y connected for 10,000 volts 3-phase. The fourth transformer is a spare, in case one of the others fail from any cause. The transformer cores are immersed in oil in cast-iron tanks which carry an outer shell. This arrangement provides a space between the tank and shell which allows of a rapid convection of the air currents and a continuous supply of cool air from the floor to carry away the heat generated from within and conveyed to the case through the oil within.

The secondary lines are carried on insulators mounted on a steel structure to a secondary bus which supplies the various secondary distributing circuits, after passing through Kelman, three-pole single-throw oil circuit breakers. A single panel of Vermont marble contains three ammeters, a volt meter, integrating wattmeters for each outgoing circuit and a graphic recording voltmeter and in some cases a wattmeter of similar type. A complete telephone equipment with the various protective devices is included. Mounted on concrete bases, outside of the building, is a set of General Electric, outdoor type, aluminum cell lightning arresters and horn gaps, and mounted on the first pole structure from either end of the building are outdoor disconnecting switches.



Henrietta Substation.
Taft Substation Interior.
Taft Substation Exterior.

Copper Mine Substation.
Fresno Water Substation Exterior.
Fresno Water Substation Interior.

The older type of station used on distributing lines is of corrugated iron on a wood frame. In most cases the buildings are 30 ft. long by 20 ft. wide. The 30,000 volt circuit is led through a gable end through

openings 12 in. in diameter. Kelman 30,000 volt, overload release, hand operated circuit breakers are used. There are three and, in some cases, six lowering transformers; these being Wagner oil immersed and air cooled, the latter action being assisted by steel fins radiating from the sheet steel cases. These stations are all equipped with Wirts carbon resistance gap lightning arresters. The outgoing circuits are controlled by Kelman switches. There is no switch board, but integrating wattmeters are mounted on a steel framework close to the outgoing circuits. These substations require little attention, except for throwing switches and reading meters. There are seven of these substations as follows: Madera, Kings River (Santa Fe rock crusher), Kerman, Reedley, Stone Correl, Selma and Corcoran.

In the towns where substations contain a switch board for local city distribution and are lighting circuits, the local conditions govern the installations, as in Merced, Lemoore, Fresno (already described under the heading of power plants) and Bakersfield.

The distribution system and substation at Coalinga are owned and operated by a separate corporation who purchase power on their own transmission line at Henrietta.

The local distribution for the city of Hanford is also owned by a separate corporation who buy power, delivered from a 30,000 volt circuit from this company at their own distributing station.

The substation at Merced is a steel frame concrete building, 30 ft. wide by 50 ft. long and adjoins the gas works. The roof is supported on five deep Howe steel trusses between the gables. This station contains three 150 kw. General Electric water cooled transformers wound for 11,000 volts primary on Y connection and 2,300 volts secondary for local city distribution. These are arranged along one side of the building and in line with them are two General Electric 50-light, a.c. arc transformers with their accompanying panel-boards. There is also a one-panel switch board on which is mounted two oil switches for city circuits. Behind this is a General Electric, 2,200 volt, 38 kw. potential regulator.

The remainder of the floor space is provided for four lines of three lowering transformers; at present but one set of three is installed. These transformers are similar to those described, having a capacity of 117.5 kw. each, being wound for Y connection voltages of 30,000 primary and 11,000 volts secondary. There are two outgoing 11,000 volt circuits. Kelman automatic overload release oil circuit-breakers are provided on all incoming and outgoing circuits.

One of the newest, most pleasing and efficient of the substations, sufficiently different from the others to deserve special mention, is that of the Fresno water company. The building is of brick, 27 ft. wide and 30 ft. long and equivalent to two ordinary stories in height. The roof is of concrete on Hyrib expanded metal with asbestos board covering and is supported on three Howe steel trusses, two of them being in the gables. There are three transformer compartments along one side, the barriers between the cells being of brick. The cells are closed on top by a mezzanine floor 4 in. thick of reinforced concrete and upon this floor are mounted two sets of Kelman automatic overload release oil circuit-breakers, one on each of the two incoming 30,000 volt lines. These circuit-breakers are connected through a bus line of 9/32 in. copper tubing, the bus in turn being divided by double break disconnecting switches. From the center of these switches are led the lines through openings in the mezzanine floor which feed the transformers. The transformers are Allis-Chalmers, 300 k.v.a, water cooled and are delta connected on the high tension side. The low tension sides deliver current at 2,300 volts. This substation is designed to be used eventually with 60,000 volts incoming lines and the transformers are wound so that they may be star connected for this potential. The switch board, or rather steel switch rack, extends the length of the building parallel to the other side. On this are mounted General Electric 3-pole oil switches and above them disconnecting switches. An ammeter is mounted on the rack for each circuit. There are eight outgoing circuits, with space for three additional; each circuit is carried through conduit under the floor out of the building, to and up the first pole, each eventually being carried to one of the eight individual pumping plants.

At the Los Banos and Mendota are two "outdoor" type substations. All apparatus except the instruments are arranged for open air operation. The high tension Kelman switches are mounted on steel frames and have a weatherproof covering. The 60,000 volt connections and transformer bushings are of a weatherproof type. A small house, large enough for the instruments and telephone, is situated somewhat away from the main apparatus. There is no regular attendant, and it is calculated that the chance of losing a transformer in the absence of an attendant does not equal the interest on the added investment of a fireproof building and the wages of a man. This type of installation is in great favor with this company.

Following is the location and equipment of all of the substations:

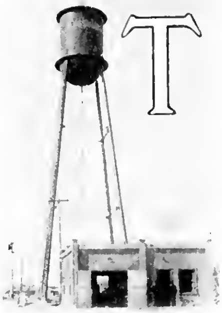
	Instld	Pr	Instld	Pr	Instld	Pr	Instld
Power House No. 3, Snelling	...	53	...	...	...	...	...
Merced (Snelling)	...	...	...	...	44	...	...
Merced District	...	...	...	...	39	7	6
Merced to Madera	...	...	30	...	42	...	...
Madera to Los Banos	...	...	75a	...	...	...	...
Madera to Mendota	...	...	...	...	...	...	...
Los Banos District	...	...		...	29	...	...
Mendota District	...	...		...	17	...	...
Madera District	...	...	...		30	...	...
Copper Mine Sub., Madera	...	...	30b	...	...	...	...
Copper Mioe Sub., Friant	...	...	...	...	13	...	...
Crane Valley, P. H. 3	...	...	...	...	5	...	...
P. H. 3, P. H. 1	...	...	11	...	13	...	...
P. H. 1, Big Creek	...	...	24	...	3	...	...
P. H. 1, Copper Mine Sub	...	...	49a	...	...	...	...
Copper Mine Sub., Tulare Sub	...	...	82a	...	21	...	...
East Side line (Prop)	...	120	...	...	...	...	...
Reedley Sub.	...	...	...	...	48	...	19
Stone Correl Sub	...	...	...	...	38	...	...
Tule P. H., Camp	...	...	...	...	9	...	...
Copper Mine, Fresno	...	...	31	...	...	...	...
Fresno, Kerman	...	...	17	...	...	...	3
Fresno, Stone Correl & Reedley	...	...	53	...	...	...	...
Fresno, Stoil	...	...	68	...	...	...	...
Fresno District	...	...	...	...	45	...	20 est.
Selma District	...	...	...	...	...	...	27
Carruthers, Raisin City	...	...	...	...	...	15	...
Hanford, Henrietta	...	...	20	...	...	...	4
Corcoran District	...	...	...	...	30	...	...
Stoil District	...	...	...	...	35	...	...
Copper Mine Sub., Bakersfield	208	...	...	...	...	...	...
McKittrick, Midway	...	...	...	...	58	...	...
Bakersfield, Famoso	24	...	...	...	100	14	...
Bakersfield, Edison, P. H.	...	...	...	...	84	...	6
Bakersfield City District	...	...	...	...	...	...	20 est.
Total, S. J. L. & P. lines	232	173	490	...	703	36	105
Coalinga, L. & P. Co.			28		38		
Additional lines to supply substations at Stone Canyon, Paso Robles, San Luis Obispo, Santa Maria		150				122	
	232	323	518		741	158	105

Total mileage of all lines operating and building, 2,077.

"a," Lines built for 60 kv. operation, but now operating at 30 kv.

"b," Lines operating at 30 kv., but soon to be rebuilt to operate at 60 kv.

Water Works Systems.



Kingsburg Water Works.

THE company owns or operates the water works in Fresno, Madera, Selma, Kingsburg, and supplies power for the operation of water works pumps at Bakersfield.

In all of these places the water is pumped from wells by motor driven centrifugal pumps into elevated tanks and also direct into the distributing mains.

The most important of these systems is for Fresno. This system is operated by a separate company owned by interests closely identified with the power corporation. There are nine wells scattered about the city, with one more about to be equipped. At each well is a substantial building, enclosing a concrete lined pit whose floors are on an average of 6 ft. below the ground surface. An 8 in. centrifugal pump, direct connected to an induction motor of from 50 h.p. to 700 h.p., completes the equipment. These pumps deliver directly into the city piping system against a pressure of 50 lb. Separate 2400 volt circuits are carried from the substation at the eastern edge of the city to the pumps, but a connection is also made from the main substation in the city to assure an unfailing supply of power. The substation at the city limits is connected to both incoming transmission lines and was placed at this point on advice of the Fire Underwriters to insure the first call on the transmission lines in case of damage to the lines within the city.

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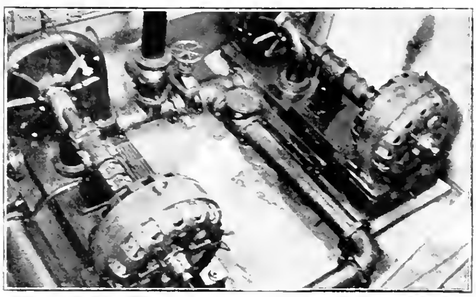


Pumps at Madera Water Works.

The most important of these systems is for Fresno. This system is operated by a separate company owned by interests closely identified with the power corporation. There are nine wells scattered about the city, with one more about to be equipped. At each well is a substantial building, enclosing a concrete lined pit whose floors are on an average of 6 ft. below the ground surface. An 8 in. centrifugal pump, direct connected to an induction motor of from 50 h.p. to 700 h.p., completes the equipment. These pumps deliver directly into the city piping system against a pressure of 50 lb. Separate 2,400 volt circuits are carried from the substation at the eastern edge of the city to the pumps, but a connection is also made from the main substation in the city to assure an unfailing supply of power. The substation at the city limits is connected to both incoming transmission lines and was placed at this point on advice of the Fire Underwriters to insure the first call on the transmission lines in case of damage to the lines within the city.

A water tower containing a 250,000 gal. elevated tank operates as a stand pipe and will supply water for the city's uses for a period of 20 minutes in case of complete interruption of the supply.

Water for the Madera system is pumped from two wells situated near the substation. A brick building

Water Tower at Fresno.

with the walls carried down to a point 12 ft. below the ground surface encloses two pumping units. The units consist of Krogh No. 7 centrifugal pumps direct connected and driven by Westinghouse, 75 h.p., 440 volt and 1,120 r.p.m. induction motors. Water is pumped directly into the pipe system and there is a wooden elevated tank of 50,000 gal. capacity which acts in connection with the system.

The water works at Selma is enclosed within the substation building. Pumping is done from two wells 180 ft. deep by two pumping units. These are placed on a level, 10 ft below the ground surface. These units are No. 6, 8 in. pumps, direct driven by General Electric, 3 phase, 35 h.p. induction motors. Connection is made between the wells, pumps and the main through a series of four check valves and two gate valves, so that either pump alone will maintain a pressure of 35 lb. on the system, which is the ordinary mode of operation for winter service; or the two pumps in multiple delivering water under the same pressure; or, by changing the position of the gate valves, the pumps will be put in series and deliver a pressure of 70 lb. which is used in the case of a fire. There is a steam pump auxiliary in a separate building near the gas

works having its own well and a second motor pump auxiliary drawing from the same well.

The water works at Kingsburg are enclosed in a concrete building which also is used for a fire department house.

Gas Works.

The company owns and operates the gas works and distribution in Merced, Selma and Bakersfield.

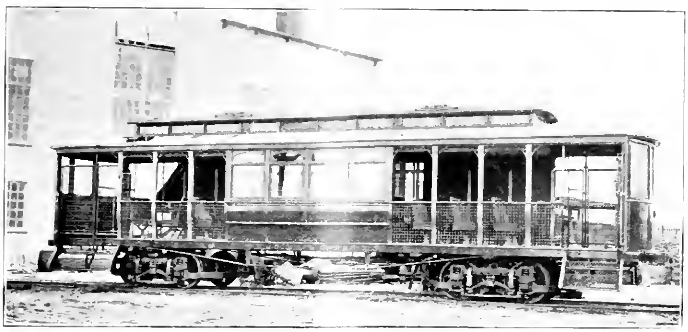
In Merced, as already stated, the gas works adjoins the substation. The plant was purchased from a local company and since its acquisition many necessary improvements have been made to bring it to its present state of efficiency. The gas making equipment consists of two "straight-shot" generators, each having a capacity of 7,500 cu. ft. per hour, one engine blower, one blower driven by a 10 h.p. induction motor and two 100 h.p. return tubular boilers. There is one 30,000 cu. ft. gas holder.

At Selma the gas works is enclosed in a corrugated iron building. The equipment consists of one "straight-shot" generator having an output of 5,000 cu. ft. per hour, one Western generator of 6,000 cu. ft. capacity, two 80 h.p. return tubular boilers, one 30,000 cu. ft. storage gas holder and one 10,000 cu. ft. relief holder. At a suitable distance from the building is placed a 500 bbl. steel oil storage tank.

At Bakersfield natural gas is used exclusively, although there is a plant, similar to those described, for making gas, which can be placed in operation on short notice.

Selma Gas Works.

Merced Gas Works and Substation.



New P. A. Y. E. Car at Bakersfield.

Street Railway System.

The only street railway system owned and operated by the company is in Bakersfield. This system has been in existence for a number of years and has been operated on a small scale by a former company. After the purchase by the present company the system was entirely remodeled and has been extended in a number of directions. Bakersfield has had a remarkable growth since the advent of the adjoining oil fields and is a city of good prospects. The wisdom of re-equipping the existing lines of the railroad will un-

doubtedly be manifest in the near future, because the possibilities of suburban extension in all directions are evident. As operated, the present system has 9.92 miles of line, including six miles of double-track. New Trilby 114 lb. rails have been laid and new trolley supports and connections make the equipment modern in every respect.

There are at present in regular use nine cars, three of these being reconstructed from the older equipment. The remaining six are of the latest California P.A.Y.E. type. They were built by the American Car Company at St. Louis. They are equipped as follows:

Trucks—Brill No. 27 G. E. I.
Motor—2 G. E. No. 203.
Gear—15.83.
Controller—G. E. K. 36 G.
Air Compressor—G. E. Type C. E.-27.
Air Valves—Style S, Form F.
Headlight—Crouse Hinds Imperial luminous arc with lens.
Trolley Catcher—Ideal.

The cars of the company are handsomely finished in a light orange color with black trimmings and add greatly to the general street appearance of the city. Power is delivered to the trolley wire directly from the steam power plant of the company.

Management and Operation.

The company is operated in two divisions, the headquarters of the Northern being at Fresno where is also the main office for the system. The Southern division is managed from Bakersfield. The main divisions are divided into districts and each of these is presided over by a district agent. It is now proposed, due to the extensiveness of the system, to give the district agents practically complete jurisdiction of their several districts, attending to all of the business of the district, maintaining their own office accounts and, as far as possible, relieve the main offices of all detail. A high class of men are employed in these positions, who have been carefully trained and selected to carry out the liberal and straightforward policy of the company.

The districts are as follows:

Northern Division.

Merced—Merced County east of San Joaquin River, all of Mariposa County.

Madera—Madera County, except generating plants and canals.

West Side—Los Banos, Gustine, Dos Palos, Mendota, Firebaugh.

Fresno—San Joaquin generating plants and canals, Fresno City, Clovis, Sanger, Malaga, Calway, Kerman, Friant, Piedra, Big Creek.

Selma—Kingsburg, Layton, Selma, Fowler.

East Side—Dinuba, Reedley, Parlier, Wahtoke, Sultana, Orosi, Stone Corral, Woodlake.

Corcoran—Corcoran, Waukena, Stoil, Angiola, Alpaugh, Lemoore, Hanford.

Southern Division.

Bakersfield—Bakersfield, Famoso, Wasco, McFarland, Pond, Edison, Lerdo, Kern River oil fields.

Midway—Maricopa, Sunset, Taft, Fellows, McKittrick.

Coalinga—Coalinga, Bradley, San Miguel, Paso Robles, Templeton, Santa Margarita, San Luis Obispo, Pismao, Arroyo Grande, Santa Maria, San Lucas, San Ardo, Kings City.

It is the policy of the company to maintain close friendly relations between the heads of departments and the men in all positions, and the latter are taught to maintain by every means possible the very liberal policy which the company has adopted in its attitude to the people at large. In this connection the company has always maintained that they were able and willing to show their good faith and desire to give the greatest satisfaction and maintain the best service and have made it a rule to build lines into a new country having possibilities for business where it might have been difficult to get the business first, but by so doing gaining the confidence and good faith of prospective customers. The good results of this policy are strongly evident on every part of the system. Disputes or grievances are given the closest attention without regard to the reasonableness or difficulty in reaching the party in question and are not dropped until thorough satisfaction is administered. In the transmission line maintenance there is one hard and fast rule—no lineman is permitted to work upon a live circuit or upon a circuit where there is another live circuit on the same pole.

The record for service, which might be expected from an organization as well systematized as this, has been good, notwithstanding the many recent changes in adopting the newer standards, and throughout the system is well worth the time necessary by the transmission engineer to study the many unique and characteristic features, the result of a development to fit the very special conditions of the territory involved.

ELECTRICITY IN MINING.

As part of its mine-accidents investigations, the U. S. Bureau of Mines is studying the problem of safeguarding life and property from the dangers that attend the use of electricity underground. One of its inquiries has to do with the removing of a possible cause of mine explosions through the use of explosion-proof motors—that is, motors with covers for those parts that emit sparks. Another investigation has to do with the determination of the most efficient and safest types of insulation for use about mines and metallurgical plants in order to protect miners and other employees from shock. Still another line of investigation relates to the possibility of igniting explosive gases through the breaking of incandescent electric lamps in the presence of such gases. Other investigations relate to the electric firing of shots and to other uses of electricity in mining operations. The preliminary recommendations of the bureau in regard to regulations concerning the use of electricity in mines have been generally accepted by mining engineers and have been incorporated in the mining law of the largest mining State.

REPORT ON STATE GAS LAWS.

The National Bureau of Standards have issued a report of all laws in the various States relating to the manufacture and testing of illuminating gas, its distribution, candlepower, heating value, purity and pressure and the testing of gas meters.

WESTERN LAWS OF ELECTRICITY AND WATER

WATER RIGHT LEGISLATION. (In California, Colorado and Wyoming)

BY A. E. CHANDLER.

Legislation regarding water rights to be complete must provide for the acquirement of rights, for the definition or adjudication of existing rights and for the distribution of water among those entitled to its use.

California.

With the reception of the Statutes of 1911, dealing with the appropriation of water for power purposes only, Sections 1410 to 1422 of the Civil Code contain all of California's legislation in regard to the acquisition of water rights.

As previously stated these sections simply provide for the initiation of rights by the posting of notices and for the benefits of the doctrine of relation if the works are completed with reasonable diligence. There is no provision for public inspection at any stage.

There are no statutes specially providing for the adjudication of water rights, and disputes between ditch owners are subject to the regular court procedure. The litigation is, therefore, between two or more claimants, and rarely are all the appropriators brought into a single action. Where there are many diversions, as is the case on the ordinary stream, there may be an indefinite number of actions without all the rights on the stream being adjudicated.

Likewise, there are no statutes providing for the distribution of water according to decree. Ordinarily the successful contestant has to resort to either force or contempt proceedings in order to obtain what the court has given him, and the former is too frequently the choice.

Colorado.

Acquirement of Rights.—The first statutes regarding water rights adopted in the various western states were patterned after those of California. The first state to make any advance was Colorado where the office of state engineer was established in 1881.

At the same session the so-called "Map and Statement" act was adopted but, owing to a defective title, was held unconstitutional in 1899. A second act, very similar to the first, was passed in 1903, and now governs the acquirement of rights. It provides that within sixty days after the commencement of the survey or of the actual construction of any ditch or reservoir or enlargement or extension thereof, a filing must be made in the office of the state engineer of duplicate maps and statements containing the information required by the act and of a form satisfactory to the state engineer. If satisfactory to the state engineer one copy is filed in his office and the other approved and certified and returned to the claimant who must within 90 days from date of commencement, file it in the office of the county clerk of county in which the headgate or reservoir lies. It is further provided that a certified copy of the map and statement shall be prima facie evidence of the intent of the claimant. The Act of 1881 provided that the right dated back to the commencement of the work upon compliance with the act and the exercise of reasonable diligence in construction. The present act is silent on this important point but where all the prescribed steps are taken the courts will undoubtedly hold that the right dates from the commencement of the work.

The state engineer has issued a circular containing the list of fees (Act of 1911), text of forms, and the rules and regulations in regard to the preparation of maps and statements. The circular states, "It is compulsory to use the forms of statements and affidavits as given herein. It will save time and delays." There is no question, therefore, but that the state engineer has a satisfactory record of the intention of new appropriators in Colorado, but there his supervision ends. Other than the provision that due diligence in construction must be exercised, the act is silent regarding any record of proof thereof, so that the claimant, in case of dispute, must settle the point in the courts, as in California. In regard to the acquirement of rights, therefore, Colorado has but slightly improved upon California.

Adjudication of Rights.—Colorado in 1879 and 1881 adopted a special procedure for the adjudication of water rights. It was provided that on or before June 1, 1881, every claimant of an interest in a ditch or reservoir within any water district should file with the clerk of the district court having jurisdiction a sworn statement setting forth among other things the date of his appropriation by original construction, also by enlargement or extension, the amount of water claimed, the existing capacity of ditch and the number of acres lying under and being or proposed to be irrigated by each ditch or reservoir. Since the date for filing such claims, June 1, 1881, an adjudication of all rights to water from a common source within a district is initiated by one or more interested persons (who have filled the required claim) petitioning the district court having jurisdiction. The judge either sets a day for the taking of evidence in open court or, as is the usual practice, appoints a referee to take and report the evidence, make an abstract and findings upon same and prepare the decree. The referee gives notice of the times and places at which he will take the required evidence and proofs of priority. In regard to the facts to be ascertained by proofs the act provides:

Said referee shall also examine all witnesses to his own satisfaction, touching any point involved in the matter in question, and shall ascertain as far as possible the date of the commencement of each ditch, canal or reservoir, with the original size and carrying capacity thereof, the time of the commencement of each enlargement thereof, with the increased carrying capacity thereby occasioned, the length of time spent in such construction or enlargement, the diligence with which the work was prosecuted, the nature of the work as to difficulty of construction, and all such other facts as may tend to show compliance with the law in acquiring the priority of right claimed for said ditch, canal or reservoir; and upon all the facts so obtained shall be determined the relative priorities among the several ditches, canals and reservoirs, the volume or amount of water lawfully appropriated by each as well as by means of the construction,

as to the enlargements thereof, and the time when each such several appropriations took place.

After closing the testimony the referee prepares the report and form of decree and files it with the court, which after properly ordered hearings either approves or modifies the same.

The act provides in detail for the many steps in the procedure and is sound from the technically legal standpoint. Its weakest point is that it does not provide for representation of the public or the state. Many of the older decrees gave to each party the amount of water claimed, which was generally far in excess of the maximum capacity of the ditch. There should have been measurements by the state engineer of the ditches and the acreage irrigated, but he is not mentioned in the act. Furthermore, the districts with which the act deals do not always include an entire stream, so that the adjudication in such cases is but partial. Aside from the trouble caused by the excess decrees, the act is to be commended as providing at so early a period in the history of irrigation a special procedure whereby most of the rights were determined.

Distribution of Water.—By an act passed in 1879 Colorado divided its irrigated territory into a number of districts generally comprising a designated creek, or creeks, and tributaries. For each district there was provided a water commissioner to be appointed by the governor from persons recommended by the boards of county commissioners interested. The principal duty of the water commissioner is to divide the waters of a stream among the ditches according to the prior rights of each, and in so doing to wholly or partially shut the headgates of the later appropriators to satisfy the earlier rights. He is also authorized to shut off the supply from any ditch so that the water delivered will in his judgment not allow a wasteful or wrongful use. The changing or interference with any headgate adjusted by the water commissioner is a misdemeanor subject to a fine of $300, or an imprisonment of 60 days, or both, and the use of water so wrongfully taken through such a headgate is made prima facie evidence of the guilt of the user. The water commissioners are further empowered to arrest persons meddling with headgates or using water procured through such. The salary of the water commissioner is $5 per day and is paid by the counties served. He does not begin work until called on by two or more persons controlling ditches in his district, or by the division engineer. He may engage necessary assistants at $2.50 per day.

In 1887 Colorado was divided into four divisions along drainage lines with a division superintendent in charge of each division. In 1903 the number was changed to five and the title to division engineers, who are now appointed by the governor from a certified list prepared by the state engineer after an examination of applicants. The division engineers receive $125 per month when actually employed and traveling expenses not in excess of $500 per annum, and are paid by the state. The division engineers have general control over the water commissioners of the several districts within their divisions, and, under the general supervision of the state engineer, execute the laws relative to the distribution of water. They may make regulations to secure the fair apportionment of water in accordance with the rights of priority. They are required to make stream measurements and rate ditches, and to perform such other duties as the state engineer may direct. Ditch owners feeling themselves injured may appeal from the acts of water commissioner to division engineer and from the latter to the state engineer.

It will be readily appreciated that the task of dividing water among ditches with valuable crops at stake is a serious undertaking, and on account of the daily variations in the flow of mountain streams requires much local study and experience. Colorado's plan of having a small number of great divisions along drainage lines each with a state official having jurisdiction therein, and a number of districts within each division of such size that the diversions may be regulated by one man and an assistant or two, was not only the first to be fixed by statute but remains the type to be followed at the present day.

Wyoming.

Acquirement of Rights.—The office of territorial engineer in Wyoming was created in 1886 but the existing legislation of which the state is so proud, came with statehood in 1890. By constitutional provision the state is divided into four divisions (the limits being fixed by the legislature) with a division superintendent at the head of each, the office of state engineer is provided, and a Board of Control consisting of the state engineer, as president, and the four division superintendents, is given "supervision of the waters of the State, and of their appropriation, distribution and diversion" subject to legislation thereon.

The statutes adopted in 1890 provide a method of acquiring rights very different from any then existing in this country. Instead of posting a notice or starting work and thus initiating a right, the intending appropriator is required to make application to the state engineer for permission to make the appropriation. The application is made on a blank form furnished by the state engineer and among other things must state the location and description of the proposed ditch, the time within which it is proposed to begin construction, the time required for completion of construction and the time required for complete application of water to proposed use. If for irrigation, the application must also give the legal subdivisions of land proposed to be irrigated. The state engineer must approve all applications made in proper form and for beneficial purposes except where there is no unappropriated water, or where the proposed use conflicts with existing rights, or threatens to prove detrimental to the public interest—in which cases he must reject the application.

If approved, the application will be so endorsed and returned to the applicant and constitutes his authorization to begin construction and perfect the appropriation.

In cases of applications in excess of 25 second feet, or to reclaim over 1000 acres, the state engineer, before acting on the application, may require additional information in regard to the financial ability and the good faith of the applicant. In the endorsement of

approval on the application it is required that actual construction must begin within one year from date of approval and that the construction must be completed within five years. The state engineer has authority to limit the construction period and the period required for application to beneficial use to a less time than asked for, and also, for good cause shown, to extend the time for the completion of works under an issued permit. Any party may appeal from any action taken by the state engineer to the Board of Control, and from an action by the Board to the district court.

Applications must be accompanied by maps prepared in accordance with the regulations of the state engineer, and profiles and plans may be required also.

The statutes do not provide the nature of the proof to be submitted by the appropriator on the completion of the works and on the complete application to beneficial use other than it "being made to appear to the satisfaction of the Board of Control that any application has been perfected in accordance with such application, and the endorsement thereon." On such a showing the Board must issue a certificate setting forth the amount of the appropriation and the number and date of priority thereof, which date shall be that of filing the application in the office of the state engineer.

In 1903 a statute specially providing for the appropriation of water for storage in reservoirs was adopted. The steps outlined above must be followed except that a description of the land is to be irrigated by the stored water is not required in the primary, or first, permit. Those who are to apply the water to beneficial use may secure the secondary permit allowing them to so do. The latter shall not be given until the state engineer is convinced that the secondary permittee has a sufficient agreement with the owner of the reservoir, the primary permittee. The 1903 statute also provides for special supervision by a water commissioner when such stored waters are allowed to run to points of use through natural channels and where loss through wrongful diversion is probable en route. When deemed necessary for the protection of the various interests involved, the state engineer may appoint an assistant engineer to superintend and direct the construction work on dams for such reservoirs.

Wyoming has thus introduced a sensible businesslike procedure for controlling new rights to the use of water. Those accustomed to the absolute want of supervision in states still following the California method of posting notices are inclined to be suspicious of the Wyoming method when first brought before them. They are especially fearful of the seeming great authority in the hands of the state engineer. An inspection of the records, however, will show so few applications rejected in Wyoming that the number is negligible. As the question of whether there are any unappropriated waters in a stream is so debatable and as the opportunity for flood waters and seepage and return waters is so great, the state engineer, in cases where there seems to be but little surplus approves the application with the following notice stamped upon it:

> The records of the state engineer's office show the waters of .... to be largely appropriated. The appropriator under this permit is hereby notified of this fact and that the issuance of this permit grants the right to divert and use the surplus or waste water of the stream and confers no rights which will interfere with or impair the use of water by prior appropriators.

Definition of Rights.—Although new to American legislation the Wyoming method for the acquirement of rights is far less novel than her method for the definition of rights. In 1886 Wyoming, then a territory, adopted the Colorado system of adjudication but rejected it in 1891 for its present system.

Instead of leaving the determination of water rights to chance cases between two or more claimants as in California, or to a special procedure initiated by a claimant as in Colorado, Wyoming, having by its constitution declared the natural waters to be the property of the state, decided to make its new Board of Control responsible for this most important matter.

The Board selects the streams on which rights are to be determined and fixes a time for the taking of testimony. The state engineer through assistants makes a survey of the ditches and the land irrigated or irrigable thereunder and measures the stream and carrying capacity of the ditches. A printed form, called "proof of appropriation," is sent to each claimant. The present practice is to have the division superintendent make the survey and have the claimant make the "proof of appropriation" on the completion of the survey of his individual holding, so that the "proofs" and survey will correspond.

On the completion of the survey and the taking of testimony or "proofs" by the division superintendent, notice is given of a time and place at which the evidence thus assembled shall be open to inspection of the various claimants. A regular procedure is provided for contests and hearings before the division superintendent, if such are required after the open inspection.

After the contests all the evidence, including original proofs and testimony taken at the subsequent hearings, is transmitted to the Board of Control. At its first regular meeting thereafter, the Board examines all the evidence and enters an order establishing the priorities of the water rights, their amounts, and the character of use of each. For irrigation rights, the maximum allowance is one-seventieth of a second foot to the acre. Certificates are issued to each claimant in accordance with the order of the Board. Appeals from the order may be taken to the district court within sixty days.

Distribution of Water.—As stated above, Wyoming has been divided into four divisions along drainage lines. The superintendents thereof have powers similar to those of the division engineers in Colorado, regarding the division of the waters among ditches entitled thereto. The Board of Control creates districts where necessary and these districts are in charge of water commissioners upon whom the actual duty of closing headgates rests. The entire Wyoming procedure in regard to this matter is copied from that of Colorado and what difference exists is only in minor details.

THE ARNOLD REPORT ON THE SAN FRANCISCO TRANSPORTATION PROBLEM.

Five preliminary reports have been made to the San Francisco Board of Supervisors by Bion J. Arnold on the transportation problem of that city. These first reports are chiefly concerned with the two matters of greatest present popular interest, ways and means of adequate transit to the site of the Panama-Pacific Exposition and the Twin Peaks tunnel. Each report carries several alternative plans with full discussion of the advantages thereof.

Of the various plans which have been presented with regard to the Twin Peaks tunnel the report favors either a low-level trolley bore as a direct extension of Market street from Valencia street to the San Miguel tract near the junction of Corbett Road and Dewey Boulevard, or preferably a curved extension of Market street to Eureka street, (following the natural contours around the northern slopes of Eureka Valley) whence a tunnel can be driven to San Miguel Rancho, emerging near T street and Dewey Boulevard with sub-grade passenger transfer station at Seventh avenue Boulevard east of Lake Honda and surface car

Present and Proposed Transportation Facilities at San Francisco

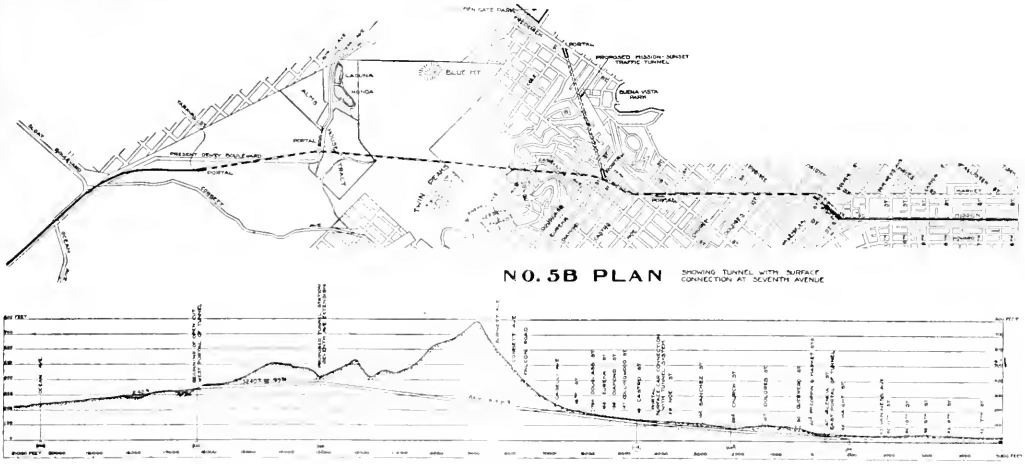
To handle the Exposition traffic it is recommended that the Fillmore street tunnel be built immediately, extending from Sutter street to Filbert street, 4,332 ft., with the necessary street widening at portals to preserve the roadways at either side for street cars, traffic and sidewalks. A tunnel through Devisadero will become a necessity at a later date. A single-bore tunnel could be built for about $2,000,000 and a double bore for $2,100,000. It is also suggested that a 2386 ft. tunnel be built under Broadway street with eastern portal at Mason and western portal at Larkin street. A short tunnel at Fort Mason would also be necessary, as well as a 1322 ft. tunnel under Stockton street. These, together with the proposed Twin Peaks tunnel are shown in the accompanying picture.

exits at Castro street and Seventh avenue. Both plans contemplate the eventual construction of a Market street subway. The latter plan would subdivide a 16,000 ft. tunnel into three parts with surface entrances not over 8,500 ft. apart.

For the main tunnel a 19 or 20 ft. arched roof bore is recommended while a flat-roof section should be used under Market street, not over 15 ft. in the clear with station platforms 15 ft. below the street crossings.

With a terminal at Valencia and Market streets it is suggested that the traffic can be effectively handled as follows:

Inter-urbans to be equipped with third-rail contact and routed direct to Valencia street underground, thence down Mission street on the surface.



Plan and Section of Proposed Twin Peaks Tunnel.

Suburban expresses to be routed the same as inter-urbans, using trolley to Valencia street.

Suburban locals to emerge at Castro, thence via Market street surface to the Ferry (or via Mission street.)

Surface feeder lines to enter the incline at Castro street, returning by an under-ground loop.

In the event of the extension of the subway to the Ferry, the entire subway bore will be available for both third-rail inter-urbans and subway locals, the suburbans being routed out of the bore at Castro or Valencia street, and the subway locals returning via underground loop at Castro street.

By the construction of this tunnel there will be brought within 30 minutes' running time of the business district, approximately 10,000 acres of new territory, 75 per cent of which is suitable for residence land, that has been practically useless heretofore by reason of lack of adequate transportation thereto.

This area extends west to the ocean front and south along the valley as far as the cemeteries. This estimate is based upon present operating schedules. But with higher speed equipment, even this is capable of great improvement and it is quite possible that the valley lands could be brought within the 30-minute zone at least half way to San Mateo.

THE ANNEALED COPPER STANDARD.

A report on copper wire tables has been made by the Bureau of Standards, Department of Commerce and Labor. The introduction states that copper wire tables are based on certain standard or assumed values for the conductivity or resistivity and the temperature coefficient of resistance of copper. When accuracy is important, the electrical engineer does not consult the wire table, but makes actual measurements of the resistivity of samples of the copper used. Frequently the resulting conductivity is expressed in per cent of the standard value assumed for conductivity. Per cent conductivity is meaningless without a knowledge of the standard value assumed, unless the same standard value is in use everywhere. But the same standard value is not in use everywhere, and confusion in the expression of per cent conductivity has accordingly resulted. The temperature coefficient of resistance is usually assumed as some fixed standard value, but the same standard value is not in use everywhere, and results reduced from one temperature to another have accordingly been uncertain when the temperature coefficient assumed was not stated. These conditions led the American Institute of Electrical Engineers to request the Bureau of Standards to make an investigation of the subject. This has been done and has resulted in the establishment of standard values based on measurements of a large number of representative samples of commercial copper—values which in certain respects are more satisfactory than any preceding standard values.

In the investigation it was discovered that the temperature coefficient is proportional to the conductivity. This new law has been corroborated by the Reichsanstalt, of Germany, and is of considerable importance in electrical measurements. It was also discovered that bending and winding a wire do not change the temperature coefficient, and consequently the internal temperature of electrical machinery may be calculated from resistance measurements with greater confidence than heretofore.

A proposal from Germany of a standard conductivity based upon this investigation has been accepted, and will probably soon be adopted all over the world. This new standard is a slightly lower conductivity than the former American value and the average of the experimental values published by the Bureau of Standards, but can be considered as substantially representative of average commercial copper.

This report gives a history of wire gages, showing that the trend of practice is toward expressing diameters directly in decimal fractions of an inch. The report contains 15 tables, including complete reference and working tables for annealed copper, both in English and metric units. Tables for copper cables and for hard-drawn aluminum wire are also given. The tables have been adopted as the official wire tables of the American Institute of Electrical Engineers.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas" August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
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CONTENTS

Errata Notice: *In the second paragraph, page 436, insert "1900 ft." as the fall from the south fork diversion to the Crane Valley reservoir and "350 ft." as the drop between Power House No. 3 and the intake of the second canal.*

An Engineer's Respect for the Flag

The engineer as a diplomat, as a commercial factor and as an arbiter in the courts occupies much attention in ethical discussions in the technical press. Little is said, however, as to whether the modern trend in concentrated power development leans toward inculcation of patriotism. In the strenuous efforts being put into centralized corporate organization, one of the most outspoken characteristics noticeable in the great body of men who make up this working scheme of action, is that of loyalty to the interests of the corporation coupled with respect and esteem for those at the head directing and upbuilding the great commercial fabric. Such loyalty imbued is noticeable to a marked degree in many of the hydroelectric enterprises of the West. In view of this fact some have wondered as to whether this was attained at the expense of a somewhat slackening in love for the state or perhaps even a deadening of national sentiment.

A little incident occurred in the recent testing of the great turbine and boiler installation at Station C of the Pacific Gas & Electric Company in Oakland. The boilers were being forced to their utmost in a run for maximum capacity. Suddenly it was thought advisable to choke the draft slightly and for this purpose some old rags were placed in the peep holes at the front of the boilers. A few minutes later H. N. Mosher, chief engineer of the plant, entered, and, with a cry of "Boys, that's the American flag," proceeded to tear down the draft shield. The exciting moments that at once ensued in his rescuing this piece of fabric which was evidently the remnant of our national emblem, will not soon be forgotten by those who witnessed this little incident.

The whole affair took place in but a minute. To many the incident may perhaps seem of small moment, but to those endeavoring to analyze the trend of national sentiment and the effect of engineering ethical ideas upon this sentiment, it had a deep and significant meaning. Loyalty to one's task in life and to those at the helm directing that task is the essence of success in any enterprise, and when we realize that with this deep-seated development of loyalty is the far deeper inner man, ready to sacrifice a world beating boiler test if necessary for the sake of rescuing a tattered remnant of a national flag, something is aroused in our innermost which tells us that not only in practical affairs but in the imbuing of the highest ethical traits, the modern engineer makes good.

The Building of An Empire

Hydroelectric projects, calling for the ultimate investment of fortunes approximating nine figures, make one stop to consider the soundness of the business sagacity directing such vast outlays of money. Fully a dozen projects of this magnitude are now being financed for the West. Most of these are already assured and are in successful stages of operation, although for complete realization of the dreams of their promoters, the future must play its share in development of our natural resources.

Agriculture is the backbone of wealth for every country that looks toward permanency in prosperity.

While mineral wealth adds to the glory and lustre of power in a commonwealth, no panic nor financial stress can be felt over prolonged periods in a section actually producing the necessities of life within its confines. The continued development agriculturally of our western states is the charm that holds all observers. Montana, a state pictured mentally by most people as resourceful in vast wealth of mineral comes now to the front with agricultural products leading the mineral output in this great treasure state. And so it is in the other states of the West. Vast areas are being cultivated, which are found world-beating in their production per acre, and, yet, a generation ago our wise fathers at Washington doubted the wisdom of even extending a protecting hand to this arid country. So great has this wealth in agricultural development been, unquestionably millions of acres will continue to be reclaimed from their arid state. Gigantic powers are necessary to successfully pump water upon the rich bench lands awaiting but this magic touch to bear a blessing to our children's children.

Not alone is the agricultural development assuming amazing proportions. The cities of the West, bordering the great ocean of opportunity soon to be realized in the readjusting of the world's commerce upon the completion of the Panama Canal, are remarkable in their present building proportions. Last month, for instance, from Bradstreet's reports we read that of all the great cities of America, San Francisco, Portland and Los Angeles were surpassed in their building operations by only three—New York, Chicago and Philadelpia. When great municipalities, like St. Louis, Detroit, Pittsburg and New Orleans, are outdistanced by the striking upbuilding of these western cities, serious-minded men in the west can see much in store for the future outlook of these cities upon the arrival of the bidding time for the world's commerce. As another comparison, indicating the magnitude of this building preparation for 1915, the summing up of building for greater San Francisco, comprising the cities around the bay, is for the past month exceeded by only New York and Chicago.

Money put into substantial building structures becomes a permanent asset to a growing community. Such moneys, once having journeyed across the continent from the great eastern markets, become a fixed asset of the West never again to leave us. When we contemplate the enormous totals to which these monthly outlays will add by 1915, we get some conception of the greatness and substantiality of the building of our western empire.

The Electric Truck

Favorable comment on the rapid growth in the use of the electric truck is of almost daily occurrence in the technical press at present. To the careful observer the introduction of the electric truck is seen to be doing its share in solving a difficult problem brought about in the sudden and unprecedented increase of population in our western cities; namely, that of aiding in solving to a degree the congestion of the public thoroughfares in the overburdened traffic centers.

The owners of several large teaming outfits have found that the employment of electric trucks makes necessary only one-half the storage space formerly required. This is no mean item of economy in cities the size of Los Angeles, San Francisco, Portland and Seattle where real estate has assumed such valuations as to make even a small space of clear blue sky an expensive item at times. Far more noticeable, however, is the material lessening of traffic congestion in districts where electric trucks are beginning to become an increasing factor in numerical comparison with the time-honored "horsepower." The pliability in operation, the smallness of space occupied, and the rapidity of transit make the electric truck a welcome new-comer to such traffic congested thoroughfares as, for instance, Mission street in San Francisco. According to city ordinance, the heavy teaming of that municipality is diverted from Market street to this thoroughfare. To the pedestrian observing the long line of vehicles wend their way before him, flashes of reflective thought formulate in his mind an opinion of the superiority of the truck in lessening traffic congestion. When he wades in to thread his way through this tumultuous array, the "impedance" experienced with a number of teams met with as compared to an equal number of trucks encountered crystallizes this opinion into a firm conviction.

The installation of the electric truck in our western cities is too recent to obtain reliable data of operation, but it is interesting to note some of the cost data compiled in New York as detailed in a paper by Chas. A. Ward before the Electric Vehicle Association. A record was given of the operation for five weeks, or thirty working days of 100 1000-lb. Ward delivery wagons used by the Ward Bread Company. Of these vehicles eighty-five are equipped with lead cells and fifteen with nickel-iron cells. The tabulation of costs included all charging, repair, and garaging expenses, but not the items of depreciation, interest on investment or driver's wages.

The best record was made by a vehicle covering 25 miles per day at a total cost of $19.57 for thirty days. The worst record was made by a vehicle covering 28 miles per day at a cost of $64.21 for thirty days. The average for the 100 vehicles was 22 miles per day, 19.9 cents per day for charging energy, 1.82 cents per day for accidents, and 80 cents per day for garaging and maintenance, the total being $1.027 per vehicle per day, or 4.66 cents per vehicle-mile. The energy cost was estimated on the basis of 1.5 cents per kw.-hr., at double this rate it is seen that the total operating expense would be increased by only 20 per cent.

When vehicle statistics show costs of from 20 to 25c per mile, now necessary in the usual methods of horse conveyance, the positive saving in many cases of the complete purchase price of an electric truck in a season or two is thus assured.

On the other hand the wide-awake central station manager is not overlooking the possibility of enormous quantities of new power sales thus made within easy reach. The time when the central station manager looked solely to lighting output for new business has now passed.

The electric truck, then, as a factor in lessening storage space for traffic vehicles, as a material aid in solving our perplexing municipal congestion problems, as a money-saver for the consumer and a money-maker for the central station, is now with us. May all profit to the fullest extent by the opportunities offered.

PERSONALS.

H. P. Wilson of New York, who is secretary of the Great Western Power Company, is at San Francisco.

J. H. McGill of the McGill Manufacturing Company of Valparaiso, Ind., recently visited San Francisco.

Arnold Pfau, hydraulic engineer for the Allis-Chalmers Company of Madison, Wis., is at San Francisco.

R. S. Buck, of the firm of Sanderson & Porter of New York, spent the past week at Los Angeles on engineering business.

H. B. Squires of Otis & Squires, who has been visiting the Eastern factories for several weeks, is expected to return to San Francisco this week.

T. L. Phillips, transmission engineer for the Pacific Light & Power Company, has returned to Los Angeles after a tour of the Pacific Northwest.

A. L. Havens, the Los Angeles manager for Pierson, Roeding & Co., spent a few days at the firm's San Francisco office during the past week.

F. C. Finkle, an engineer who has been connected with Southern California hydroelectric developments for some time, recently visited San Francisco.

J. C. Temple, the Chicago manager for the Morgan-Smith Company of York, Pa., manufacturers of water wheels, is at San Francisco on contract business.

H. V. Carter, president of the Pacific States Electric Company, is making an eastern trip and will be present at the Atlantic City jobbers' convention.

C. D. Wheeler, publicity manager for the Fort Wayne Electric Works of the General Electric Company, is attending the Shriners' convention at Los Angeles.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is expected at San Francisco next week on his return from a flying trip to Yokohama.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, has returned to his headquarters at San Francisco after an extensive trip through Oregon and Washington.

Morgan B. Speir, division commercial superintendent of the Southern Bell Telephone Company, with headquarters at Charlotte, N. C., is at Portland, Ore., after making a tour of California.

C. F. Ubelacker, chief engineer for Ford, Bacon & Davis of New York, is visiting the firm's San Francisco office while making a tour of the Pacific Coast on general engineering business.

H. D. Donnell, representing the Safety Car Heating & Lighting Company on the Pacific Slope, has returned to his San Francisco office after a business trip to Denver via Salt Lake City.

N. W. Graham, who is in charge of the Holabird-Reynolds Company's store at Los Angeles, has left for the East and will attend the electrical jobbers' convention at Atlantic City, N. J., in June.

F. A. Somers, who now has the title of manager of the railway and lighting division of the Westinghouse Electric & Manufacturing Company's San Francisco office, recently visited Southern California.

Wynn Meredith, of the San Francisco office of Sanderson & Porter, has just returned from Vancouver, B. C., after inspecting the engineering work which is being conducted under the supervision of his firm.

W. S. Berry of the Western Electric Company's San Francisco office, has left for Chicago and the Eastern states. He will visit Atlantic City during the forthcoming convention of the electrical jobbers.

Rudolph W. Van Norden, consulting engineer, has removed his offices from the Nevada Bank Building to the Rialto Building, San Francisco. He spent the past week investigating the Clear Lake power project.

Sidney Sprout, engineer for the California-Oregon Power Company, has gone to Siskiyou county on work connected with the new development on the Klamath River for which machinery contracts were recently awarded.

B. C. Carroll, general agent for the Pacific Telephone & Telegraph Company, has returned to San Francisco after spending two months at Seattle and Northwestern points. He reports a rapid growth of business at Portland.

P. W. Greenleaf, formerly superintendent of the Pacific Power Company at Mono Lake, Cal., has resigned to accept a position with the Southern Sierra Power Company at Paris, Cal. W. K. Bellinger of Los Angeles has succeeded to his position.

H. B. Smith, professor of electrical engineering at Worcester Polytechnic Institute, is a recent San Francisco visitor. Mr. Smith is just completing a year's trip around the world, during which he has visited many of the great hydroelectric enterprises of the Orient.

Thomas Mirk of Hunt, Mirk & Co. has returned to San Francisco from Portland. **K. G. Dunn,** representing this firm, was at Tulare last week when the new steam plant of the Tulare County Light and Power Company was accepted by the owners, after a successful test run.

Garnett Young, manager of the Telephone-Electric Equipment Company, is at Los Angeles on his way home from the East after attending the annual meeting of sales managers of the National Metal Molding Company at Pittsburg and visiting the factories represented on the Pacific Coast by his firm.

C. H. Rattray, electrical engineer, with the General Electric Company, Colman building, Portland, is actively engaged in collecting pumping data regarding practices and costs of systems for irrigation work. This is in connection with one of the largest propositions yet projected in the Greater Northwest.

J. B. Lukes of the engineering staff of the Stone & Webster Company is at San Francisco to open an office at 413 Rialto Building.. Among the representatives of Stone & Webster forces who visited San Francisco during the past week are: **E. B. Bumsted,** engineer; **H. A. Hageman,** chief designer of the Fresno office, and **D. L. Roberts,** in charge of the field commissary department.

Newcomb Carlton, vice-president of the Western Union Telegraph Company, arrived at San Francisco from the East during the past week on an inspection tour. He was director-general of the Pan-American Exposition at Buffalo. He visited the Panama-Pacific International Exposition site as a guest of the exposition directors.

B. C. Condit, engineer for the Northwestern Light & Power Company, a Fleishhacker enterprise, is at San Francisco. He is interested in closing contracts for hydroelectric generating machinery for its new developments to transmit power to Portland, Ore., on a large scale. Bids are in for two 10,000-kw. generating units.

Samuel G. McMeen, member of the engineering firm of McMeen and Miller of Chicago, recently was elected president of the Columbus Railway & Light Company of Columbus, Ohio. The Columbus Railway & Light Company operates all the electric traction, lighting and power properties of the Columbus Edison Company, the Columbus Light, Heat & Power Company, the Columbus Traction Company and the Columbus Railway Company. Mr. McMeen's new connection is a promotion from the presidency of the Mt. Hood Railway & Power Company of Portland, Oregon. He remains a partner of the firm of McMeen and Miller.

IN MEMORIAM.

Hinsdill Parsons

As the result of an automobile accident, Hinsdill Parsons, vice-president and general counsel of the General Electric Company, was instantly killed near Albany, N. Y., Sunday afternoon, April 28th.

Although but 48 years of age, Mr. Parsons had shown himself to be one of the ablest corporation lawyers in the country. For nearly a dozen years he has had charge of the law department of the General Electric Company, and his abilities have been well proven in the solution of the many perplexing legal problems which naturally arose in the development of this rapidly growing industry.

In 1907 Mr. Parsons took an active part in the work of the rehabilitation of the Knickerbocker Trust Company, later becoming one of its directors,—a position from which he later retired.

He was largely responsible for the remarkable development of the Schenectady Railway Company, the Schenectady Illuminating Company and the Mohawk Gas Company—being president of the two last named companies at the time of his death.

Mr. Parsons was a director of the Electric Bond & Share Company, the Washington Water Power Company and the Schenectady Power Company.

Mr. Parsons maintained a residence in Schenectady where he spent considerable time during the summer, but his business affairs kept him in New York City much of the time.

Mr. Parsons was a member of the Mohawk Club and the Mohawk Golf Club of Schenectady, and was deeply interested in many other local organizations. He was also a member of the University, Metropolitan, St. Andrews, and St. Nicholas Clubs, and of the Down Town Association in New York City. He had a wide circle of friends among the leading legal and electrical men of the country who mourn his loss. He was deeply loved by all his friends and by all who knew him.

Hinsdill Parsons, a son of the late Mr. and Mrs. J. Russell Parsons, was born in Hoosick Falls, February 10th, 1864 and received his higher education at Trinity College and at the Albany Law School, graduating from the latter in 1885. Four years later he was appointed patent attorney for the Walter A. Wood Harvester Company of Hoosick Falls. He became associated with the General Electric Company in January, 1894, and in April 1901 he was elected vice-president.

As head of the law department, Mr. Parsons directed the legal affairs of the company and was assisted at the Schenectady office and in New York by a large staff of lawyers.

He is survived by his wife, Jessie Mary Burchard, who is a sister of Anson W. Burchard, who holds the office of assistant to the president of the General Electric Company. Also by three brothers, Willard P. Parsons of Cohoes, and Edgerton and Walter Wood Parsons, both of New York City.

The funeral services were held from St. George's Church, Schenectady, Tuesday afternoon, April 30th.

J. P. Ludlow, who was connected with J. G. White & Co as an appraiser, was injured in an automobile accident which caused his death May 7th. While returning to Bakersfield from an electric power plant which he had inspected, the automobile in which Ludlow was riding plunged over a forty-foot embankment. He was taken to Bakersfield and given the best attention, but failed to rally. He leaves a widow, who resides at Berkeley.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

The bids for the Tivoli Opera House on Eddy street ran too high and the plans are being revised.

The John G. Sutton Company has been awarded the electrical work on the Fleishhacker Building on Bush street and Grant avenue.

The Central Electric Company has been awarded a contract for wiring a large warehouse for the Blinn Estate on Second and Brannan streets.

Fred Greisberg, formerly superintendent of construction for the Decker Electric Company, has entered the electrical contracting business with headquarters on Golden Gate avenue.

The electrical workers in Portland are striking for higher wages. Paul Butte of the Butte Engineering & Electric Company and H. C. Reid of the Pacific Fire Extinguisher Company are both there looking after the interests of their companies, who have several large jobs.

TRADE NOTES.

The offices of the Bowie Switch Company and A. J. Bowie Jr. have been moved from the Lick Building to 913 Nevada Bank Building, San Francisco.

The Holabird-Reynolds Company have been made the sales agents of the Schwarze Electric Company of Adrian, Mich. They manufacture high-grade electric bells.

Ray D. Lillibridge, incorporated, specialists in technical advertising, announce the removal of their offices to suite 2109-10-11-12 Trinity Building, 111 Broadway, New York City.

The Portland Railway, Light & Power Company, Portland, Ore., will soon install new transforming apparatus in its stations consisting of six 750 kva., 11,000-2400 volt units which have been ordered from the General Electric Company.

The McGill Manufacturing Company, after carrying a stock of their lamp guards, solder-flux material, etc., in San Francisco for some time, have discontinued their local agency. The stocks have been taken over by the Pacific States Electric Company, the Western Electric Company and the Holabird-Reynolds Company.

The Pelton Water Wheel Company has sold to the Grangeville Electric Light and Power Company a 550-h.p. Pelton-Francis turbine water wheel of the horizontal, cylindrical, steel-encased type, to operate at 600 r.p.m. under a head of 59 feet. The new generating unit will be a duplicate of one that has been in operation about two years at the Grangeville plant.

The Pacific Gas & Electric Company has outgrown its big office building and additional offices and display rooms are being fitted up in the building formerly occupied by the Metropolitan Light & Power Company at 422 Sutter street. H. P. Pitts, industrial agent for the company, and John H. Hunt, purchasing agent, will remove their departments to the new location.

The General Electric Company has the contract for supplying and installing the electrical equipment for the new planing mill of the Stimson Mill Company at Ballard station, Seattle. This will include a 1500 kilowatt steam turbine generator and about 50 motors, aggregating 1600 horsepower. The generator is a 3-phase, 60 cycle type, being direct connected to the Curtis steam turbine.

The executive offices and New York show rooms of the H. W. Johns-Manville Company, manufacturers of asbestos, magnesia and electrical supplies, were moved on April 20th to the new twelve-story "H. W. Johns-Manville Building," Madison avenue and Forty-first street, New York City, from their old quarters at 100 William street, where they have been located for the past 15 years.

The Holophane Company and the Fostoria Glass Specialty Company have been consolidated into one organization to be known as the Nelite Works of General Electric Company, with headquarters in Cleveland, Ohio. The factories will remain in Fostoria and Newark. The Holophane Engineering Department will also remain in Newark for the present. The removal of sales and accounting departments and the change of name takes place as of April 29, 1912.

The Electric Storage Battery Company of Philadelphia has recently closed a contract with the New York Edison Company for the installation of four additional "Exide" batteries to the forty-five batteries this company now has in service. This contract is the largest ever made for storage batteries in central station service, the four batteries having a capacity at the emergency rate of 138,620 amperes. One of these batteries will be the largest central station battery in the world, having an emergency output of 48,140 amperes. All of the 49 batteries for the New York Edison System have been built and installed by The Electric Storage Battery Company. They have an output at the one hour rate of 158,330 amperes.

BOOK REVIEWS.

Alternating Current Design. By Julius Frith, M. Sc., M. I. E. E., Size $5\frac{1}{2} \times 8\frac{1}{2}$ ins.; 115 pages; 27 illustrations; cloth binding. Published by D. Van Nostrand Company of New York, and for sale by the Technical Book Shop, Rialto Building, San Francisco. Price, $2.00.

In the preparation of this book, the author, Julius Frith, who is a consulting engineer and special lecturer in electrical design in the Manchester University, has aimed at the compilation of a companion book to Mr. Cramp's "Continuous Current Machine Design." Armature reaction and the relation of dimensions to output occupy two of the fourteen chapters. An illustrative example of the design of an alternator next follows. The induction motor, the transformer and transmission lines with choke coils and other accessories are taken up in able and logical order. Severe mathematical deductions are avoided. Emphasis of the inward physical meaning is effectively brought out in the development of the theory of design. The book will be found of much practical use to those engaged in design and especially for students in design.

Engineering Valuation of Public Utilities and Factories. By Horatio A. Foster, author of "Electrical Engineers' Pocketbook." Size 6 x 9 in.; 345 pages; replete with tables and form sheets. Published by D. Van Nostrand Company of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $3.00.

No more welcome book has appeared for some time than this excellent treatise on engineering valuation of public utilities. The recent action of the California State legislature in putting public utility corporations under the control of the State Railroad commission is typical of the trend of the times. Mr. Foster as author of the well-known Foster's Electrical Engineers' Pocketbook speaks with the authority and experience of a lifetime devoted to compiling data of vital interest to the electrical engineer. The book is systematic and logical in its arrangement. The first chapter deals with "value" and its various ramifications. Such terms as tangible and intangible assets, obsolescence, amortization, good will, going concern, depreciation, appreciation, franchise value and capitalization are treated in the fullest manner. The final three chapters are devoted to control of public utilities, court decisions and bibliography. The form sheets taken largely from the Wisconsin Commission standards add a completeness to the work lacking in recent books and papers along similar lines. The book is invaluable to engineers dealing in any way with valuations of public utilities or with questions of rate making.

The Art of Illumination. By Louis Bell, Ph. D. Second Edition; thoroughly revised, enlarged and reset. Size, 6x9¼ in.; 353 pages; 171 illustrations; cloth binding. Published by McGraw-Hill Book Company and for sale by the Technical Book Shop, Rialto Building, San Francisco. Price $2.50.

The art of illuminating engineering has been enriched by a large amount of valuable experience within the past few years, and its principles are now founded on a more secure scientific basis. In the detailing of these principles in clear, lucid, simple style it is doubtful if any American author is the equal of Dr. Louis Bell. There is something in his charm of expression which makes dry facts and figures not only profitable reading but intensely interesting. This book has been thoroughly rewritten and brought down to date and may be said to represent the last word on illumination. The author starts out by describing the natural characteristics of light in its physiological relation to the human eye. Then follow the principles of color, reflection and diffusion. After treating next the subject of standards in light and photometry the various lamps with their reflectors follow. Exterior and interior illumination is interestingly discussed. The book is technical and yet so artfully written, the layman or at least one versed but little in affairs electrical can understandingly read it. To any one interested in the live subject of illumination, a library without it present is most incomplete.

A. S. C. E. CONVENTION NOTE.

Pacific Northwest Society of Engineers, Captain A. O. Powell, president, is co-operating with the local committee of the American Society of Civil Engineers for the entertainment of the members of the latter society at its annual convention in Seattle, June 25-28, 1912. The Northwest Society has appointed the following co-operating committee: J. T. Heffernan, chairman; Robert Moran, Dean Milnor Roberts, George P. James, Henry L. McGillis, A. B. Coe, Stirling B. Hill and M. J. Falkenburg.

AMERICAN ELECTRIC RAILWAY ASSOCIATION REPRESENTATIVES VISIT THE WEST.

Traveling 8000 miles, traversing 30 states and visiting 29 cities is part of the general plan of the officers of the American Electric Railway Association.

These men were banqueted at the Palace Hotel in San Francisco on Friday evening, after having enjoyed a pleasant and profitable sojourn in Los Angeles. They will visit Portland on May 14. From there they will visit Vancouver, B. C., after stopping in Seattle.

As the officials of the American Electric Railway Association the 12 or 14 men represent 1300 electric railway companies which own 42,000 miles of track, 90,000 cars, and carry annually between 10,000,000,000 and 11,000,000,000 passengers. These companies employ 250,000 persons.

The party left New York in the private car Advance on April 17, and they expect to step off the same car in the same city at 9:30 on the night of May 29.

"We are traveling across the country to bring about a better understanding between the electric railway companies and the communities they serve," said Thomas N. McCarter, president of the association, recently. "We want to enable the railway companies to appreciate more fully the benefits which these two associations bring to them along the lines of standardization and efficiency."

Mr. McCarter is at the head of the Public Service Corporation of New Jersey.

INDUSTRIAL

SPARK GAP LIGHTNING ARRESTERS.

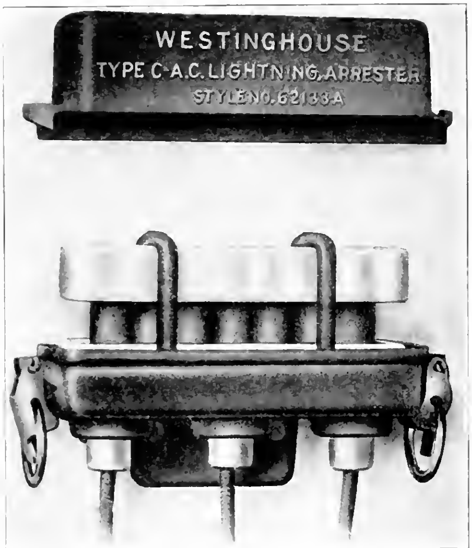
Static protective apparatus, to be effective, must act exactly like a safety valve; it should allow no current to pass at the ordinary pressures, but at undesirable pressures above normal it should provide sufficient freedom for the flow of current to limit the pressure to safe values, and it should cease to take current and resume its inactive condition the instant the excessive pressure is relieved. The simplest and therefore the least expensive form of lightning arresters that fulfill these functions are of the spark gap type.

Type MP Lightning Arrester.

The illustrations show two types of spark gap arresters for low-voltage use, manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The type MP is used on cars, on lines, and in stations, for railway service, and the type C is an inexpensive device for the protection of overhead lines.

The type MP or multipath arrester, for use on 440 volts alternating current or 600 volts direct current, has for its working part a block of special composition, over the surface of which the discharge spreads itself along a number of minute discharge paths. The voltage across each gap is very small, but owing to the large number of gaps the line voltage can not maintain an arc across them. The arrester has an indefinitely long life and affords a freedom of discharge very great compared with ordinary air spark gap types.

For installation under various conditions, three different styles of enclosing cases are furnished for the type MP arrester. In all three the cases are of galvanized iron and substantially constructed. The covers close against felt gaskets and are held by rugged spring-toggle latches. The car mounting style is so constructed that when the cover is removed the working part comes out with it; it is therefore convenient for mounting under car sills and in other inaccessible places. The pole-mounting style has the mounting lug located at the bottom, so that the cover can be removed for inspection without dropping out the working part. The conduit-wiring style is mounted in a larger box having a conduit hole tapped with standard ¾-in. pipe thread; the ground lead is connected directly to the box, and the conduit system should be grounded.



Type C Lightning Arrester.

About five type MP arresters per mile are recommended by the manufacturers for line protection, and one on each car.

The type C arresters, for 500 to 2500 volts alternating current, consists of seven cylinders of non-arcing metal mounted between overhanging porcelain supports and enclosed in a weather-proof iron box. Leads are brought out from the first, last, and middle cylinders. For lines up to 1250 volts, one arrester can be used as a protection for both sides of a two-wire circuit, the middle lead being grounded. On higher voltage one outside lead is grounded and the arrester is single-pole. The static charge spreads over the surface of the cylinders and jumps across the gaps between them. This lightning arrester, because of the large size of the cylinders, has an instantaneous current capacity that materially aids in clearing the line of disturbances, while its equivalent spark gap is extremely low. This device has successfully withstood the test of hard conditions and gives reliable protection under the conditions for which it is intended.

The type C arrester is intended for use on circuits having a capacity not exceeding 200 kilowatts if installed within a radius of two miles from the source of power. An additional capacity of 100 kilowatts is permissible for each additional mile. These limits are specified by the manufacturers to allow for the ability of the arrester to successfully suppress a power are following a discharge.

A NEW CURRENT TRANSFORMER FOR HIGH VOLTAGE SERVICE.

BY S. P. RUSSELL.

To those familiar with the current transformer, the tedious description of the inter-related electric and magnetic paths and their various uses would be as tiresome to the reader as to the writer. Volumes of analysis have been written and are easily accessible to those who desire such, some of the best being procurable at the Bureau of Standards, Washington, D. C.

The current transformer dates back to the beginning of alternating current practice, but it has lagged behind other electric apparatus in design, finish and reliability. Originally it was a safety device, permitting the removal of dangerous wires from the switchboard, and from direct contact with all instruments that might be handled.

When the high tension transmission systems were first placed in service, no current transformers were developed for such severe duty. There were many other pressing problems to solve, without trying to do much with relays, meters or automatic switches on the main line, and hand control was the rule of operation. All current was metered at the generator voltage, or else the meters were placed on the low voltage side of the receiving transformers.

With the enormous growth of power transmission systems, and their network of lines, high voltage current metering became necessary and the current transformer was also wanted for the operations of relays and trip coils. The percentage of failure that followed the trial of the early high tension current transformer greatly retarded its general use. Its weakness was in the design and method of insulation.

Its lack of efficiency is well illustrated by the following story related by a friend, who stated that on a recent trip to Los Angeles, while in conversation with an engineer, the statement was made (and seriously), that they could set their watches by the current transformers. On being pressed for an explanation, the engineer stated, that at some critical stage or condition of the load at regular intervals, one or more high voltage current transformers would have its "baptism of fire," with the usual accompaniment of interrupted service, etc. This story, of course, is an exaggeration of facts, but it is so far true that current transformers for high voltage service are in bad order, due to excessive cost and unreliability, that they are omitted in many cases where it is a real hardship to do without them.

These conditions demanded something better, with the result that there is now on the market a current transformer which is practically immune, and which lacks the time keeping quality of its predecessors. This transformer is unique, standing alone in an apparent contradiction of all supposedly sensible and reasonable apparatus, and performing the duties for which it was conceived, i. e., a reliable twenty-four hour a day means of registering the power flowing in high tension power lines. Fewer parts and a simpler construction cannot be obtained, and this piece of apparatus is considered final in the essential qualities of simplicity, permanent high insulation and safe operation.

The current transformer is comprised of outlet bushing with copper bar terminals,—or primary leads, molded in. This bushing is mounted on the cover, and in turn supports the transformer carcass in the following novel manner: The carcass is comprised of one porcelain bushing, one primary coil, two secondary coils, one cast copper shackle (in two parts), and the laminated iron core.

The bushing is recessed at both ends to admit the secondary coils, and the outside waist of the bushing is contracted to hold the primary coil. The two parts of shackle are insulated from one another by suitable fibre blocks and bushings, and the insulating coupling held together with two bolts passing through metal flanges, fibre block and bushing, thus making a strong rigid shackle, which is bolted to the primary leads. The two ends of the primary coil are electrically connected to the shackle in such a manner that the shackle is always one turn of the primary winding, i.e., part of the first, and part of the last turn. With the laminated iron core passing through the bushing and suspended therefrom, we have the novel condition of a transformer hanging by its primary leads.

By this simple means of suspension the task of insulation is so much lightened as to be easily accomplished. The secondary leads are brought out through a rigid metal conduit which is attached to the cover, which results, when removing the cover, in the removal of the whole transformer. This is so light that with the exception of the 100 kw. transformer, one man can easily handle it.

The tank is a one-piece boiler plate, acetylene-welded tank, and the assembled transformer filled with clean dry mineral seal oil is practically indestructible when subjected to the service for which it is intended.

This transformer is patented, and is made for three principal voltages, i.e., 40,000, 60,000 and 110,000 volts. It is built for any range of current from 5 to 500 amperes, the secondary coils being wound for 5 amperes on all sizes.

This is sold exclusively by the H. W. Johns-Manville Company, who are manufacturing it in indoor and outdoor types in all voltages up to 150,000 volts.

NEW CATALOGUES.

In Circular 202 the D. & W. Fuse Company of Providence, R. I., have published interesting and valuable information on Magnetic Chucks for machine shop use.

The latest bulletin the Kellogg Switchboard & Supply Company have to offer the telephone trade, is the Number 60, on Construction Material, Tools and Miscellaneous Supplies. Every effort has been made to list in this bulletin, the best materials, apparatus, etc., of proven merit.

The Westinghouse type T direct-current turbo-generator, consisting of a Westinghouse steam turbine direct-connected to, and mounted on, a common base with a direct-current generator, is fully described and illustrated in Descriptive Leaflet 2158 just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. A full description of the various characteristics and construction details of the turbine is given, and numerous views of the component parts of the various elements, the completed machines, and installations are shown.

The General Electric Company has issued a number of new Bulletins. No. 4922 is devoted to Electriicty in Metal Mines and contains illustrations and descriptions of d.c. and a.c. apparatus for every phase of mining work. No. 4933 describes Small Polyphase Motors, Riveted Frame Construction. No. 4934 is concerned with Battery Charging Rheostat and No. 4935 with the G. E. 201-A Railway Motor. No. 4941 gives an exposition of the theory and use of Water Flow Meters. No. 4942 relates to the Thomson Direct Current Test Meter. No. 4943 to D. C. Motor Starting Panels for Heavy Service and No. 4944 to Isolated and Small Plant A. C. Switchboard Panels.

The Kellogg Switchboard & Supply Company have just issued several interesting pamphlets. "Some 1912 Acknowledgements of Unsurpassed Kellogg Service," contains many sincere and strong testimonials in favor of Kellogg apparatus in use throughout the world. The booklet contains 16 pages with a buff colored border design for each page. Kellogg Moisture Proof Cords are described in two four-page folders, one in English and one in Portuguese. Information given in these little folders will interest many operators who have the problem of cord inefficiency with which to contend. A second edition of the little booklet entitled "Things Telephone Users Should Know About Telephone Systems and Service," is another of their recent publications.

NEWS NOTES

INCORPORATIONS.

KENT, CAL.—The Kent Electrical Manufacturing Company, $5000, by A. A. Risedorph, George Schurman and others.

SAN FRANCISCO, CAL.—K. P. F. Electric Company, $20,000, shares $10 each, subscribed $30, by A. S. Kalenborn, A. J. Pohl, J. B. Francis.

SAN FRANCISCO, CAL.—Bachman Electric Company, $10,000, shares $2 each, subscribed $104, by J. N. Bachman, J. Lynch and L. Crowley.

SAN FRANCISCO, CAL.—Domestic Water Company of Santa Maria, $150,000, shares $100 each, subscribed $300, by C. H. Zeus T. A. Allan and A. B. Eddy.

DEL NORTE, CAL.—Mountain Power Company, $1,500,000, by F. P. Brewer of Pasadena, Carrie M., H. S. and J. S Owen of Los Angeles and F. D. Stout of Chicago.

POMONO, CAL.—Articles of incorporation have been filed for the Limited Mutual Water Company, with capital stock of $20,000. Directors are Chas. W. Churchill, L. W. Cushman and F. A. Squires. The lands in the incorporation are about midway between Upland and Claremont. The company is organized to drill and excavate for water.

ILLUMINATION.

WALLOWA, ORE.—A deal has been consummated whereby Geo. Jacobs of Portalnd becomes the owner of the Wallowa Light & Power Company.

PORTLAND, ORE.—The taxpayers of the city of Vale have authorized an electric light and power franchise for the Idaho-Oregon Light & Power Company.

ANTIOCH, CAL.—The Pacific Gas & Electric Company has begun serving the people of Oakley, Knightsen and Brentwood with electric light and power.

DEER PARK, WASH.—F. E. Parks and some leading business men of this place are organizing a light and gas company and have asked for a 25-year franchise.

BURBANK, CAL.—Sealed bids will be received up to May 25 for a franchise to build and maintain for 10 years, an electric light and power system under and along the streets of this city.

GLENDORA, CAL.—Sealed bids will be received up to June 4 for a franchise to erect and operate for 50 years, piers, masts, poles and other structures transmitting electricity, in and along certain streets.

PORTERVILLE, CAL.—A franchise has been granted to the Home Gas Company for a period of 50 years to construct and maintain a system of gas pipes along all public roads and highways within the city.

AMERICAN FALLS, IDAHO.—The total expenditure for the erection and equipment of the new power house to be erected by the Idaho Consolidated Power Company, at this place, will reach the $1,000,000 mark when completed.

OXNARD, CAL.—First steps have been taken toward the issuance of bonds in the sum of $30,000 for the construction and completion of a municipal street lighting system. Said bonds shall be 60 in number, of $500 each, bearing 5 per cent interest, payable semi-annually on May 1 and November 1. Two of said bonds shall be payable May 1, 1922, and two on same date each year thereafter until all are paid.

PORTERVILLE, CAL.—The Central California Power Company has petitioned the Railroad Commission for the grant of an application for a stock and bond issue of $40,000 with which to purchase the properties of the Home Gas Company for $40,000 in Porterville and the franchises in Exeter and the franchise in Tulare County. The Commission will hear the application on May 7, spending the morning in Exeter and the afternoon in Porterville.

SAN FRANCISCO, CAL.—The Oro Electric Company, successor of the Oro Water, Light & Power Company, has placed on the market here $3,500,000 first mortgage bonds, the proceeds from the sale of which will be devoted to the development of gigantic power projects in Superior California. The company operates at present two hydroelectric plants in the Sierras with a capacity of 4009 h.p. and about 50 miles of distributing system, and furnishes electricity for light and power in Oroville and the adjacent country, besides owning all of the electric, gas and water business in Oroville and vicinity.

WALA WALLA, WASH.—The efforts of the city of Pendleton to secure a municipal power plant to the Walla Walla River above Milton are apt to meet with a severe and permanent setback, if the plans of a number of the property owners along the stream are carried out. The plan of the property owners, according to the current report, is to take water from the Walla Walla River just below the tailrace of the Pacific Power & Light Company, and erect a power plant for the purpose of erecting, which the Walla Walla River Power Company has been organized and incorporated. The representatives of the new company have secured plats of the proposed pipe line of the Pendleton proposition, and the idea is to block the efforts of the county seat people in securing a right of way for the line.

TRANSMISSION

BOISE, IDAHO.—The Southern Idaho Light, Heat & Power Company will extend its interurban line from Caldwell to Ontario and Weiser. R. L. Ewing is the engineer in charge.

VICTORIA, WASH.—It is reported the contract with the Westholm Lumber Company to put in the Sooke Lake power plant has been canceled by the city authorities. This work involves several million dollars. It is supposed the work will be advertised.

KLAMATH FALLS, ORE.—The California-Oregon Light & Power Company, which will build a dam 90 feet and 250 feet long to generate electric power for the surrounding country, has awarded the contract to furnish 50,000 barrels of cement to the Big Basin Lumber Company of this city.

SALEM, ORE.—With developments in the office of State Engineer Lewis today it is practically certain that a gigantic fight is being waged between the Hill and Harriman lines to secure one of the greatest power assets in the Willamette Valley. The fight is waging over power possibilities in Clear Lake and the McKenzie River. The Southern Pacific recently filed with the State Engineer asking to use the waters of Clear Lake and McKenzie River for development of 36,000 horsepower, using 400 second feet and a fall of 800 feet, the improvements to cost in the neighborhood of $1,600,000. But this filing was apparently balked by a prior filing of the McKenzie Valley Irrigation & Power Company, which asked for water for irrigation as well as power.

LOS ANGELES, CAL.—C. A. Blackmar, head of the de-

partment of oil inspection is preparing an ordinance which he will soon submit to the City Council, regulating the laying of oil pipe lines in the city. There are now within the city more than twenty-five miles of oil pipe lines, ranging from four to ten inches. Each is laid according to its owners' own specifications. Future pipe lines wi l be laid according to the city's plans, if this ordinance is adopted. The present lines frequently break, because of electrolysis; but special provision will be made to avoid this trouble, and provision will also be made for the placing of gates at certain intervals, so that when there are breaks the oil can be shut off readily and damage may be minimized.

TRANSPORTATION.

PORTLAND, ORE.—It is reported that the Southern Pacific Company has bought the A. Welsh electric lines in Willamette Valley, including the Salem street car system.

CORVALLIS, ORE.—At the last meeting of the City Council a franchise was granted to the Portland, Eugene & Eastern Railway Company. The company will start work at once.

SAN BERNARDINO, CAL.—Bids will be received up to May 27, for the purchase of a franchise to construct and operate for fifty years an electric railroad over and across certain streets of the city.

VANCOUVER, B. C.—The British Columbia Electric Railway Company announces it will start the construction of a line from Main street west on Sixteenth avenue, along the boundary of Point Grey. The work will be rushed to completion.

SAN FRANCISCO, CAL.—Prominent electric railway men, headed by T. H. McCarter, president of the American Electric Railway Association, and president of the public service corporation of New Jersey, visited San Francisco this week. The delegation consists of twelve.

MERIDIAN, CAL.—Work on the new $300,000 bridge across Butte Slough for the Marysville and Colusa branch of the Northern Electric Railroad Company, will be started soon. The contract for the foundation has been let. The total amount of the contract will run close to $100,000.

OAKLAND, CAL.—Announcement is made by officials of the Southern Pacific Company of the awarding of contracts for the grading and road work on the Melrose-San Leandro extension of its transbay service. Actual construction of the work will be commenced within two weeks.

PORTLAND, ORE.—A 1200-volt electric system copied after its Oakland and Berkeley, Cal., interurban lines, will be installed by the Southern Pacific on Fourth street, here, if the City Council grants its application to electrify the line, according to A. H. Babcock electrical engineer for the Harriman railroads.

SAN FRANCISCO, CAL.—The Geary Street Railway ceased operations on May 5, and the work of constructing the new municipal road started the next day. Except for the short line to the beach, the new contract embraces the completion of the entire roadbed. Mahoney, the new contractor, is allowed 180 days to finish the work and will be given $200 for each day which he saves under the specified time. He has announced that he intends to get the bonus and that he will make the "dirt fly."

SACRAMENTO, CAL.—Application for permission to construct ten public road crossings at grade has been made by the Northern Electric Company to the State Railroad Commission. It is the first application of the kind to be filed with the Commission and complies with the provisions of the new public utilities law making it necessary for a railroad to obtain the Commission's permission before constructing a crossing on a level with a public highway. These crossings are on the Northern Electric extension from Marysville to Colusa.

SEATTLE, WASH.—Charging that a conspiracy exists between Trustee Augustus S. Peabody, Peabody, Houghteling & Co., and other financial interests to deprive him of his $1,000,000 worth of stock in the Seattle, Renton & Southern Railway, William R. Crawford, president of the company, has procured the appointment of Scott Calhoun as temporary receiver for the railway company. Judge King Dykeman made the order requiring the defendants to appear in court on Friday at 1:30 p. m. and show cause why the receiver's appointment should not be made permanent. In his complaint filed, Mr. Crawford asks judgment against Augustus S. Peabody, and Peabody, Houghtellng & Company, for $1,000,000 damages. The action is directed against these, and the railway company and the First Trust & Savings Bank of Chicago.

SAN FRANCISCO, CAL.—The annual report of the United Railroads for 1911 shows an increase in gross earnings of $232,647 and an increase of net earnings over 1910 of $254,947. The 1911 gross earnings amounted to $7,886,136; the net reached $3,179,165. The total income of the United aggregated $3,443,792, an increase of $429,295, and its expenses and taxes amounted to $4,706,971, a decrease of $22,299. The sinking funds aggregated $339,619, a decrease of $27,451, and the surplus is shown to be $1,008,960, an increase of $407,051. Out of $1,008,960 surplus of 1911 $473,168 was paid out for renewals, depreciations and contingencies, and $350,000 for dividends on first-preferred stock. Filed with the United Railroads' report was the income account of the Sierra & San Francisco Power Company, for 1911, as follows: Gross earnings, $834,324; expenses and taxes, $258,271; net earnings, $576,053; charges, $328,326; net income before depreciation, $247,727.

PORTLAND, ORE. — The Portland Railway, Light & Power Company has sold $5,000,000 5 per cent 2-year notes to J. & W. Seligman Company of New York and E. W. Clark & Company of Philadelphia. The company controls street railway and electric light and power properties in Portland. Proceeds from the note sale will be used to acquire the Mt. Hood Railway & Power Company of Portland. The notes which are callable on 60 days' notice after November 1, 1912, are secured by the deposit of the entire issue of first mortgage 5 per cent 30-year bonds and all the capital stock, $5,000,000 authorized and $1,000,000 issued, of the Mt. Hood Railway & Power Company. The bonds are convertible into stock of the company at par, at a price for the stock equal to the amount paid in on stock, plus $1 on each $100 share. Earnings of the company for fiscal year compare as follows:

	1911	1910
Gross earnings	$6,336,703	$5,638,896
Operating expenses and taxes	3,069,897	2,724,378
Net earnings	3,266,806	2,914,518
Interest charges	1,510,280	1,398,029
Balance	1,756,526	1,516,489

WATERWORKS.

MONMOUTH, ORE.—Bids for the bonds to be issued for the new $20,000 water system have been opened and the bid of the Lumbermens National Bank of Portland accepted.

TWIN FALLS, IDAHO.—Arrangements are now under way for providing Burley with up-to-date water and sewer systems. The village board has had the matter under consideration for some time.

REDLANDS, CAL.—Recommending a bond election for $600,000 for a municipal water system, Engineer F. E. Trask of Los Angeles and City Engineer George S. Hinckley of Redlands have filed their report for a municipal system for Redlands with the water commission and the City Trustee. Three new reservoirs are proposed and the system provides for new pipe lines on all streets and 70 miles of pipe line.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII — SAN FRANCISCO, MAY 18, 1912 — NUMBER 20

PACIFIC COAST TRIP AMERICAN ELECTRIC RAILWAY ASSOCIATION OFFICIALS

The party of electric railway officials who are making a trip of eleven thousand miles through the South and West, in order to promote more cordial relations between public utility companies and their customers, are now visiting the Pacific Coast. In the party are Thomas N. McCarter, president of the American Electric Railway Association and of the Public Service Corporation of New Jersey; Oscar T. Crosby, president of the Wilmington & Philadelphia Traction Company; Charles C. Peirce, railway manager of the General Electric Company; Arthur Warren, representative of the committee on public relations of the Association, and H. C. Donecker, secretary and treasurer of the Association.

The party was met at Los Angeles by officials of the local electric railway companies, including General Manager C. A. Henderson, Superintendent John J. Akin, Chief Engineer G. J. Kuhrts, Master Mechanic E. L. Stephens and Superintendent of Electrical Repairs J. L. Clarke, of the Los Angeles Railway Corporation, and Vice-President Paul Shoup and General Manager J. McMillan, of the Pacific Electric Railway Company, and the lines and shops of both companies were inspected. At a luncheon at the Los Angeles Athletic Club, May 6th, leading citizens of Los Angeles and public officials and representatives of civic bodies were present. Captain Osborne, president of Chamber of Commerce, was toastmaster, and speeches were made by Messrs. McCarter, Crosby and Peirce of the visiting party, and President Thomas E. Gibbon of the Harbor Commission of Los Angeles. Mr. Gibbon spoke of the increasing area of the city and predicted that ultimately a territory twenty miles through would be embraced within the city limits. He said: "It would be eminently unfair to make an electric road carry a passenger twenty miles for five cents," and he suggested that a remedy might be found in the establishment of the zone system.

Banquet to Visiting Officials, American Electric Railway Association at Palace Hotel, San Francisco.

On the following day, May 7th, Pasadena was visited, and a trip up Mt. Lowe over the lines of the Pacific Electric Company was made. The visiting officials were tendered a luncheon at the Hotel Maryland, where, as at Los Angeles, representative citizens of Pasadena, public officials and officers of the Board of Trade were present. Vice-President W. F. Knight of the Board of Trade presided, and the other speakers were Messrs. McCarter and Crosby of the visitors, Dr. Mattison, Mr. Kerrigan of the committee to frame a city charter, and Secretary Bertinau of the Board of Trade. Mr. Kerrigan said he thought it a good omen that the railroads were trying to get closer to the people, and typified the change of attitude by contrasting the remark attributed to Commodore Vanderbilt with the recent utterance of William McAdoo. "The more we have of this 'public be blessed' spirit," he said, "the better we shall get on together."

Wednesday, May 8th, was spent at Santa Barbara

The members were met on their arrival at San Francisco by a committee consisting of Chas. N. Black, second vice-president of the association, and S. K. Colby, W. E. Amaan and Thomas Finigan of the local committee. After being taken in automobiles to their headquarters at the Palace Hotel the officers of the association and some of the local railway men were taken over the lines of the United Railroads of San Francisco by Chas. N. Black in the United Railroads' private car. A stop was made at the Cliff House and the party was taken to Burlingame, arriving at the Burlingame Country Club at about 1:30, where luncheon was served. From the club, automobiles took the party around the Spring Valley Lakes to the Geneva street shops of the United Railroads, finally reaching the Palace again at 6 o'clock p. m.

Friday morning, through the courtesy of the officers of the San Francisco-Oakland Terminal Railways, the Eastern visitors with other guests of the Oakland officials, met at the Key Route Ferry at 9:30 a. m. and after a trip around the bay took a special electric trin to Berkeley, where automobiles were waiting to take them throughout the town, lunch being served at the Claremont Country Club. After lunch the automobile trip was continued through Piedmont and Oakland, return being made to San Francisco by a special electric train of the Key Route system.

Friday night at seven o'clock a reception and banquet was given under the auspices of the local members of the American Electric Railway Association and the American Electric Railway Manufacturers' Association. In addition to the Eastern visitors, there were present as guests the Hon. James Rolph, Mayor of San Francisco, the Hon. Frank K. Mott, Mayor of Oakland, the Hon. John M. Eschleman and the Hon. H. D. Loveland, railroad commissioners of the State of California; supervisors of the city of San Francisco, Fred L. Hillmer, Oscar Hocks, Adolph Koshland, Byron Mauzy, Chas. A. Murdock and Alexander T. Vogelsang; Wm. Corbin, president of the Association of Improvement Clubs, Louis H. Peterson and R. M. Searle, vice-president of the Rochester Railway & Light Company, of Rochester, New York.

The other members and guests present were as follows:

Addison, Dr Thos.	Forbes, John F	Murphy, Chas
Alberger, W R.	Foster, S. J	Noack, H R
Allen, F. W.	Frost, F. W	Nougues, J M
Alvord, R. M	Halloran, A H	Oellig, H H
Amann, W. E.	Handlon, J H	Parsons, E T
Aronson, D. A.	Hanscom, P T	Phelphs, Ralph I
Bissell, W. A.	Harris, Jas W	Pike, C. W.
Bivins, W. F.	Heise, Carl E.	Piode, L E W
Blivin, C. M.	Henes, L G	Potter, J. P
Bowden, R. A.	Heron, E. A	Reardon, J S
Briggs, W. W.	Hibbs, E. D	Richards, F A
Brown, J. Q.	Hilis, C C	Robertson, C H.
Buck, R. S.	Hobson, J S	Russell, H A
Bullard, A. W.	Hockenbeamer, A. F.	Saurman, A B
Bulotti, C F.	Holabird, R. D.	Schindler, A D.
Bumsted, E. B.	Holberton, Geo. C.	Seaver, W H
Burns, E. O.	Hullin, N J.	Sibley, Robert
Carr, Richard B.	Hunt, J. H.	Smith, E N
Chapin, F. E .	Gillispie, T C	Smith, H F
Clapp, F. B.	Goodwin, W. L	Snedaker, W H
Clapp, H. W.	Green, H B	St. Pierre, Geo.
Clark, Horace S.	Gregory, T T C.	Skeel, F. F.
Colby, S. K.	Jones, Allen G.	Steiger, J S
Coleman, S. Waldo	Jones, F. H	Still, A H
Conn, Chas. F.	Jones, J. P.	Stuckenholt H
Corbin, M. M.	Kieffer, S. E.	Thompson, A A
Crilly, J. E.	Koch, Gustavus	Thompson, Jos S
Davis Jr., W. J.	Lardner, Henry A.	Treadwell, J W.
de Remer, J. G.	Legare, B. P.	Tripp, C M
De Wolfe, Chapman	Liggett, J. C.	Wallace, J H.
Down, S. G.	Lisberger, S. J.	Willcut, Geo. B
Drake, F.	Lukes, J. B	Wise, Jas H
Edgar, B. C.	McMullin, Latham	Wolcott, L. H.
Ferguson, J. C. H.	Mitchell, H. A.	Yount, J. M.
Finigan, Thos.	Mullally, Thornwell	Zabriskie, C .B.
Foote, D. H.	Murphy, Geo. R.	

Doctor Thomas Addison, Pacific Coast manager for the General Electric Company, acted as toastmaster and introduced as the first speaker Alex. T. Vogelsang, chairman of the public utilities committee of the Board of Supervisors, who welcomed the visitors to San Francisco. Mayor Mott of Oakland, the next speaker, likewise gave them the freedom of the transbay metropolis.

Thomas N. McCarter, president of the American Electric Railway Association, said: "Without entering the field of political discussion, I may say, at the outset that in the present period of agitation concerning not only the railroads, both steam and electric, but practically all large business enterprises, one of the most important questions confronting the people of this country is whether the electric railway industry shall be crushed between the demagogue on the one hand and the doctrinaire on the other, or shall be given an opportunity to live and to expand in accordance with the needs of the public and fair play to the investors.

"It is not to be denied that in many minds a feeling of prejudice toward electric railway companies exists. No doubt this is in large part due to the fact that in the early stages of the industry policies were adopted which would not in this enlightened day be tolerated for a moment. But whatever may have been the case in the past, I am prepared to say that, in the nearly ten years during which I have been connected with this business, the men engaged in operating electric railways throughout the country, according to my observation and I have had unusually good opportunities for observation have been, with very few exceptions, honorable men, conducting an honorable business in an honorable way.

"Contrary to the general belief, the electric railway industry has not been, on the whole, a profitable one. While in the first few years of the business some large fortunes were made—and perhaps improperly made—these have been exceptions. As a fair sample of the real earnings of electric railway companies, I may cite conditions in Massachusetts. In that State there has been a commission with power to supervise the issuance of securities during the entire twenty-four years of the life of the industry. Consequently there have been no stock-watering scandals, and a dollar of capitalization in any of the companies operating there unquestionably represents a dollar honestly invested. Yet only approximately one-half of the electric railway companies in Massachusetts pay dividends, and by the dividend paying companies the average rate paid is but six per cent. There are people, I know, who say that six per cent is the maximum rate which ought to be permitted in the case of securities of this kind, but I have no hesitation in saying that if, after experiencing all the trials and tribulations and peculiar hazards of this business, and going through the lean years of slight dividends, or none at all, the best I can hope for in this business, after a quarter of a century of development, is six per cent, then I prefer to put my money in a savings bank and let it earn four per cent, without the risks and worries of public utility companies.

"Senator La Follette says that the steam railroads of this country have a capitalization of eleven billions of dollars, and that they could be duplicated for six billions of dollars. From this he argues that there are five billions of water. He proposes to squeeze this out and begin over again. I hold no steam railroad securities myself, but I say to you that if any such doctrine as that advocated by Senator La Follette were put into effect in this country, there is not a hearthstone in the land, however humble or remote, that would not have a shadow cast across it by that proceeding. These securities were issued under due forms of law, and with the acquiescence, if not the approval, of the public. At that time everybody was trying to get aboard the band-wagon. Furthermore, the securities have now been scattered far and wide. The man who did the job of watering, if watering there was, has, in the vernacular of the day, 'got away with the goods.' He has unloaded the securities on the public, and those who now hold them are, for the most part, honest purchasers for value. Behind these purchasers, in the last ten years, has come the man who, relying on the stability of business affairs in this country, has said: 'I will take a lease on that property, and pay three or four per cent, or whatever the rate may be, on those securities, which the State has stamped, and I will take my profit from the earnings over that.' And he has put his good, honest money into the enterprise. Now suppose, under such circumstances, a commission orders a reduction of rates. Whatever that reduction may be, and whatever may be the revenue produced by the business, he is not relieved from his liability to pay the amount guaranteed by the lease. The man you mean to hit is not the man who is actually hit. Those who suffer are those who, least of all, ought to suffer, those who have invested their honest money in the property.

"As a matter of fact, I believe there is little, if any, water in the securities of these companies at the present time. It must be remembered that the electric railway industry is still young. All the equipment used in it has been developed, in less than a quarter of a century, from the very crudest beginnings. No other business, consequently, has been subjected to so great a loss in the same period of time through the necessary scrapping of expensive equipment, as older types have been succeeded by later and more improved ones. When this element is considered, together with the increased value of permanent property, such as real estate, I believe it will be found that, in most instances, there is no over-capitalization, and that, in fact, replacement value and capitalization will about balance.

"One of the most difficult problems that we have to meet in the operation of electric railways is the fixed unit of fare. It seems to be thought, sometimes, that there is no limit to the elasticity of the nickel. As communities grow, electric railway lines are being constantly extended and the transfer system widened, so that the distance which may be traveled for a five-cent fare becomes steadily greater. The result is that the nickel is being continually diluted. We receive, in reality, not a nickel, but three and a half to four cents. Yet the cost of everything which enters into the construction, equipment and operation of electric railways is advancing. Electric railway companies, like their customers, are feeling the effect of the increased cost of living. We have to pay more for labor, for coal, for steel rails, for the money we must raise in order to further develop our properties—in short, for everything we require—than was the case a decade ago. In the nine years of my connection with it, the cost to our company for labor has advanced five cents per car hour per man, involving an annual total of approximately half a million dollars. Electric railways are in the position, in many cases, of furnishing service for less than cost. Manifestly this state of affairs cannot continue indefinitely. The remedy may lie in the increase of fares, where an increase is equitable, as has been permitted in Massachusetts, or in the adoption of the zone system, which is in vogue abroad. In the latter event, a passenger would be permitted to ride anywhere within the limits of a fixed zone, embracing, perhaps, the territory within a radius of three miles from the center of a city, and if he traveled beyond the zone limits, would be charged for the additional ride in proportion to the distance traveled. This would put the sale of transportation on the same basis as the sale of other commodities and the only basis which is economically sound. In other words, the passenger would pay for what he got.

"You will hear it said that the public would be benefited by competition among public utility companies. That, in my judgment, is a fallacy. History has a habit of repeating itself, and if, in a city where one company is operating an electric railway, a franchise be granted to a second company, in five years there will be but one company, while the public will be paying in fares for the support of two. The electric railway is a natural monopoly, and because it is a natural monopoly, it should be regulated. I believe in public service commissions, if they are composed of sober, thoughtful, courageous men, who will not be influenced by the blandishments of corporations on one hand, nor by the desire for popular applause on the other, and if the law creating these bodies and defining their functions be a sane one. By sane I mean a law which confers upon these commissions the power to supervise, as distinguished from the power to administer the affairs of public utility companies. It is proper that the commissions should have the power of supervision regarding fundamental things, such as capitalization and, perhaps, rate-making, but when the law goes further and turns over the entire administration of the companies to commissions, you have the worst possible form of municipal ownership—municipal ownership without municipal and financial responsibility.

"In the building up of American municipalities there has been no more important factor than the electric railway. It has enabled the workingman and the man of moderate means to leave the congested parts of the city and establish his home in pleasant and healthful suburbs. It has opened up new areas to residence and business, and thus has created taxable values and added to municipal revenues. It has performed a great work, but the task yet to be performed is even greater. There are forty thousand miles of electric railways in the United States. Yet we have only scratched the surface of the people's need in this

regard. Only by the co-operation of the public can we place this industry on a basis which will enable us to meet every honest obligation, maintain the high standard of efficiency which the public has a right to expect, and obtain the capital necessary for the further expansion and development of these enterprises. The citizen's interest in the continued prosperity of public utility companies is as great as that of the men charged with the active conduct of those companies, and between the companies and the public there should be, not hostility, but a recognition of mutual needs, and a united effort to meet them."

Oscar T. Crosby spoke as follows:

"Natural rights and natural justice are will-o'-the-wisps which no wise man pursues. If three men, Smith, Jones and Brown, be cast upon an island, the conjunction of Smith and Jones on any scheme of government must be accepted by Brown, and the views of the two former will be the measure of the practical rights and justice of the government thus established. It need hardly be supposed, however, that Brown will always find ineffable wisdom and light in the determination of Smith and Jones, although he must, as a matter of fact, yield to them. If he wishes to continue to exist, he must endeavor to persuade the majority which rules him that measures destructive of his existence shall be changed. He may ever do Smith and Jones a good service by pointing out that rules prescribed by them at the moment will, if applied generally, result in evil for all parties concerned.

"The street railway industry just now, in many parts of our country, is little Brown endeavoring to modify the opinions of Smith and Jones, the great public which controls him. It is fully understood by those in this industry that they, like any other citizens, may be crushed unjustly by the voice of the people. These are the very conditions of life, and I, for one, have no desire to suggest any modification of the principle that the majority shall rule, even though I full well recognize that this principle may be applied in such fashion as to destroy myself or others in ways which I should consider unjust. Government is the organized justice and the organized injustice of society—of the people who live under some general agreement as to the occupation of a part of the earth's surface. We want, therefore, that our criticisms should be considered as the criticisms of good and obedient citizens who, even in asserting their own rights, may be doing not only a selfish act of self-preservation but also be serving some larger purpose in standing for principles which are important to others, as well as to themselves.

"A street railway company consists of a small number of men who make an agreement with all the others, represented by their government, to do certain things for those others. The very fact that the government in question, whether it be city or state or nation, has it within its power to be unjust, should make it a matter of greater concern that the agreement be very explicitly drawn, leaving as little as possible of tyrannical power to be exercised in ways other than those pointed out in the contract. In other words, the agreement should be as simple as possible, and as nearly automatic as possible, and it is not desirable that any citizen, in his relations to his government, should be largely left to be dealt with by that over-worked word "reasonable," which is now on every lip. Men have cut each other's throats and devastated fair cities since the world began by way of expressing differences of opinion concerning what is reasonable. This is particularly true when the word is made to apply ex post facto. Indeed, it may be said that no rule which is unknown is reasonable.

"The contracts between the public and street railway companies, as they generally appear in the United States, are not as carefully drawn as would be desirable, looking to the interests of both parties. Looking back over the past twenty-five years, during which I have had more or less to do with the development of the art of street railway work, I can see that on both sides there was haste at the beginning. Old horse railway franchises were patched and mended by men inexperienced in such matters. I speak with freedom on the subject, as I myself had a good deal to do with a number of such operations when all of us were forced to feel our way. Somewhat later it became my duty to go over a number of European franchises or concessions. They are wearisome in the extreme, but they are far more satisfactory from the point of view of being specific than those which generally control our operations.

"Today, only a short time, as such things are measured, after the investment of large sums of money in a riskful business, it is the fashion to set very low limits to the earning capacity permitted to such capital. There can be no doubt whatever that, had there been so much as a suspicion twenty-five years ago that money thus risked would be now limited to six per cent, no man would thus have ventured his funds. It chanced that as general superintendent of the Sprague Electric Motor Company, which was the company which established on a commercial basis here the electric railway business for the whole world, I had charge of the manufacture of such early installations. I say, therefore, as one having authority, that those who put their money in street railway enterprises twenty-five, twenty-four, twenty-three or twenty-two years ago, were buying the best and worst motors possible at the time, as they were the only motors doing commercial work. Every detail of the art was full of vexatious uncertainties, and nothing was more uncertain than the matter of return to the capital thus invested. But those who were engaged in the new work were young and enthusiastic. They believed, as turned out to be the case, that they were establishing a new and great art, which would benefit the whole public. They believed that it would yield large profits. Their first prediction as to the benefit to the whole public has been universally realized. Their second prediction, or hope, has been realized only in a few cases. It is just this hope, however, that keeps the world going. It is just this confident belief on the part of young men that they or their associates will make large profits that permits inventions to pass through the period of wearing and killing trial.

"We are measurably past the doubts as to the mere working of the machinery. We are not past another difficulty which surrounds all of men's enterprises, that is, the mistake in judgment as to earning capacity from a territory into which lines may be built.

And further, even if hopes of traffic be immediately realized, changes in the character of a neighborhood or in the whole growth of a city may seriously alter the conditions of profit. We have also met with an immediate doubling of the cost of service on each car. We hoped at the beginning that a motorman could operate the car and fares be collected in fare-boxes in the old-fashioned way then widely spread in the horse-car service. We now know that a conductor must be on every car. Both of these employes have had largely increased wages. A hundred burdens have been taken up, and borne, and the business has shown, it must be recognized by all, a remarkable elasticity. It has thus far, however, called for an investment so great that only the supposition of the possibility of considerable profits could have continued the stream of gold that has gone into the ground.

"A confused conception that large profits have been made — larger somehow than some one thinks they should be—is now possessing the public mind. It seems not improbable that, if the facts were known, the unrest in this respect would be allayed. The country is strewn with wrecks of railway enterprises. I have on a good many occasions, for myself and associates, bought street railways at foreclosure sales at the same reduced prices as those which attract one to an auction counter. Only recently, near the city of Trenton, New Jersey, where I now administer the principal street railway interest, lines aggregating 30 miles or more, built by Tom and Al Johnson, so widely known in the street railway world, were sold at a loss to the estates of those two eminent street railway men of $700,000 or $800,000 out of a total investment of approximately $1,700,000. I mention this case, not because it stands alone in regard to ratio of loss, but because the chief loser, Tom Johnson, brilliant man as he was, excellent politician as he was, made just such mistakes as may befall any of us in the art in which he was the prophet of low fares.

"With respect to fares, there is a particular pressure upon the companies, because, to do any business at all, a very large investment in rails must be made, and having this fixed investment, it becomes necessary to induce as much travel as possible, and it is perfectly obvious that a large volume of travel cannot be had at high rates. Reasonable as it is to assume that the normal, wise selfishness of the companies would take care of the rate, we must now recognize that in some way the public prefers to control this subject. It did undertake the control when it granted franchises permitting a five cent fare, and by implication permitting, and indeed inviting capital to an unlimited return, save as the limit would be fixed by the conditions of the business itself. If now, in the mere exercise of its sovereign power, the public intends to invalidate those contracts, it should first contemplate the fact that a certain injury is done to all investments based upon confidence in the contract-keeping quality of the public. If, in spite of all this, it is yet determined to make such a limitation, directly or indirectly, it must be obvious that anything like a six per cent rate established for money invested in the past constitutes a denial of what every common-sense man must know to have been the conditions surrounding the contract when made. No man goes into a riskful business on that rate. He should not be held down to it after having passed through the risks and established a success. So far as money required for future development is concerned, the case will, in a measure, take care of itself. Any error made by the public in fixing the limit too low will retard the development of properties and in time the lesson will be duly learned.

"In the end we must all worship at the shrine of this trinity—good service, good wages, good dividends. There can be no development of one of these persons of the trinity without a corresponding development of the other. Good service is the very object of the whole effort, so far as the public is concerned. Good wages ought to be the object of desire of the heart of every employer in the land. Good dividends must be either earned or hoped for, in order to produce the inflowing streams of capital which our growing cities require for their public utilities. Those officials who believe that the good service and good wages can be had without good dividends will undoubtedly be taught their error by the inexorable logic of events."

Charles C. Peirce spoke of the obligation of the manufacturer; R. M. Searle on "The Corporation Dollar," and W. W. Briggs gave the benediction.

On Saturday morning at 10:15, through the courtesy of A. H. Babcock, electrical engineer of the Southern Pacific Company, the party was taken to the Alameda Pier where a special train was in waiting. The car shops, power house and substation of the Southern Pacific Company's electrified lines, were inspected and the party arrived in San Francisco again at 12:30 p. m. Some of the visiting gentlemen were taken to the Bohemian Club where a luncheon was served. During the afternoon, a trip to Chinatown was made and the visitors were taken to the Cliff House, for supper, in the private car of the United Railroads.

No formalities attended Sunday and at 8:20 the party took the Oakland Ferry to join their private car which had been ferried across the bay and attached to the evening train for Portland.

The visitors arrived in Portland Tuesday morning, May 14, and passed the day there, leaving for Seattle and Spokane at midnight.

The plans for their entertainment at Portland includes a motor-boat trip upon the river, a trip about the city in automobiles and in observation cars, luncheon at the Commercial Club and a reception and banquet, followed by a program of speeches at the club in the evening.

George F. Trowbridge was chairman of the committee on general arrangements. Other members of the committee have been made chairmen of sub-committees with power to select their assistants. C. B. Merrick was chairman of the committee in charge of the banquet; E. D. Timms, J. K. Gill and F. McKercher managed the entertainment for the noon hour; J. H. Haak, chairman of the automobile committee, and G. F. Shepherd, chairman of the river excursion committee.

Elaborate arrangements have also been made for the reception and entertainment of this committee at Seattle and Spokane. The officials are greatly pleased with the result of their trip to date and it is believed that it will greatly redound to the benefit of the association and the electric railway industry.

WESTERN LAWS OF ELECTRICITY AND WATER

WATER RIGHT LEGISLATION. (In Idaho, Nebraska, Nevada and Utah.)

BY A. E. CHANDLER.

In the previous article, legislation regarding the acquirement of water rights, the definition or adjudication of such rights, and the distribution of water among ditches entitled thereto was discussed for the States of California, Colorado and Wyoming. It was shown that the first two of these essential points, enumerated above, are best cared for in Wyoming, and that both Colorado and Wyoming have the same excellent system regarding the third point. The next state to radically change its water right legislation was Nebraska, in 1895. The other states which have acted wisely did so in the following order: Idaho, Nevada and Utah in 1903; New Mexico, North Dakota, Oklahoma and South Dakota in 1905; Oregon in 1909. The legislation in the first four of the above states will be briefly discussed in this article and the review of the existing situation in all of the western states reserved for the next number.

Nebraska.

In 1889 Nebraska adopted legislation providing for the appropriation of water by posting notices as in California, but in 1895 introduced an entirely new system closely following that of Wyoming. As the State at that time was in financial straits it aimed to create as few new offices as possible and therefore provided that its state board of irrigation should be composed of the governor, attorney-general, and the commissioner of public lands and buildings. In 1911 the name of the board was changed to "The State Board of Irrigation, Highways and Drainage." The board appoints an hydraulic engineer as secretary and he is known as the state engineer. The striking difference between the statutes of Wyoming and Nebraska is the comparative brevity of the latter—otherwise the Wyoming language is closely followed.

Acquirement of Rights. The sections providing for the acquirement of rights are practically the same as those of Wyoming. The application is made to the board (the secretary, or state engineer, acting for the board) on a printed form furnished by the state engineer, and when in proper form is approved "if there is unappropriated water in the source of supply * * and if such appropriation is not otherwise detrimental to the public welfare." It is elsewhere further provided, however, that "if a prior appropriation has been made to water the same land to be watered by the applicant" the application shall be rejected.

It was undoubtedly intended by those who drafted the section that a "prior appropriation" meant a perfected appropriation—that is actual use, or potential use, of water on the land. It is rather an empty expression from any practical point of view and is one instance where the Wyoming section was not followed. Unfortunately for the state the expression was construed by its Supreme Court in Farmers' Irrigation District v. Frank (100 N. W. 286) and it was held that the board could not approve an application to irrigate any land described in an approved application. As the law did not provide that an applicant must make any showing of his title or interest in the land described, the effect of the decision was to deprive one of his right to appropriate water for the simple reason that some promoter had described his land in a former application which had been approved without any notice to the land owner.

In the case cited, Frank had described thousands of acres belonging to residents of the Farmers' Irrigation District. The case was decided in 1904 and although it evoked bitter criticism from those deprived of what they believed to be a "natural right" the section was not amended until 1911, when the following words were inserted, " * * * and no permit to irrigate any land shall be allowed unless the owner or owners of such land shall give consent to the same in proper form, duly acknowledged before some officer legally qualified to take acknowledgements."

Definition of Rights.—The "definition of the priorities of right to use the public waters of the state" is left to the board of irrigation. Instead of fixing a detailed procedure as in Wyoming the statute provides that "the method of determining the priority and amount of appropriation shall be determined by the said state board." The board accordingly has adopted rules to govern the taking of "proofs of appropriation" and hearings in cases of contests.

As in the case of applications to acquire rights, the real work is left to the state engineer. Most of the determinations of the old rights have been made without actual surveys by the state engineer. The state was, therefore, quickly covered, but it is probable that in some cases larger acreages were allowed than should have been.

After the completion of the determination "certificates of appropriation" are issued to appropriators, as in Wyoming, the maximum allotment for irrigation being one second foot for each 70 acres and in no case to exceed three acre feet per year (as amended in 1911). Appeals may be taken to the district court within 60 days of the determination.

Distribution of Water.—The system for dividing water among the ditches entitled to its use is the same as in Colorado and Wyoming. By statute the state has been divided into two divisions with division superintendents in charge. Before 1911 the title was "under-secretary."

Prior to 1911 the state board created districts within the division on the petition of interested parties, but in 1911 the board was empowered to divide the divisions into subdivisions and the latter into districts as they believed necessary. The board appoints one water commissioner for each district. (Prior to 1911 the title was "under-assistant.") In 1911 it was provided that appropriators on April first of each year must give the division superintendent a list of the lands to be watered during the year.

Idaho.

The office of state engineer was created in Idaho in 1895, but his duties were principally in regard to operations under the Carey Act until the adoption of the "new legislation" in 1903.

Acquirement of Rights.—Idaho follows the system introduced by Wyoming of making intending appropriators apply to the state engineer on printed forms furnished by him. The instructions issued by the state engineer state that "application will not be accepted nor permit granted thereunder, unless the following instruction are carefully carried out, in preparing the application blank and maps"—it being required that duplicate maps must be filed before the permit will be granted and where the application is for more than 25 second feet the maps must be prepared from actual surveys.

As the Idaho constitution provides that "The right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses, shall never be denied," the right of rejecting applications deemed detrimental to the public welfare, etc., has not been delegated to the state engineer, but he must approve all applications made in proper form and contemplating application to beneficial use.

The maximum allowance for irrigation purposes is one second foot to 50 acres, and the maximum time allowance to complete the construction of works is five years and that for applying water to beneficial use four years in addition thereto. (The state engineer has no authority to extend the maximum time allowance. Such authority is given in other states and should be as the limits set are too small for the larger projects.) It is further required that one fifth of the construction work shall be done in one-half the time allowed and adverse claimants may contest the right when this is not done. For appropriations not in excess of 25 second feet construction work must be commenced within sixty days of issuance of the permit, and for other appropriations a bond in an amount to be fixed by the state engineer, not exceeding $10,000, must be filed within the said sixty days with the state engineer as a guarantee that the work will be completed as provided in the permit.

The 1903 Idaho statute was the first to provide a regular procedure for proofs of completion of construction and also proofs of complete application to beneficial use. At least sixty days prior to the date set for the completion of the works the holder of the permit must notify the state engineer of readiness to submit proof, on a form furnished by him containing among other information the amount of water such works can carry and, if for irrigation, the description of the land which can be irrigated. In cases of diversions in excess of 50 second feet the facts set forth in the notice must be certified to by a competent irrigation engineer. The notice is published by the state engineer in a paper of general circulation in county where works are situated and such publication also states the time and place of submission of final proof. Before the time set the state engineer has the works inspected and after such time, and the consideration of any protests which may be made, he issues a certificate stating among other things the purpose of works, the quantity of water which can be carried to place of use, and, if for irrigation, a description of the lands for which water has been made available by the works.

The same procedure is followed in submitting proof of complete application to beneficial use. If satisfied that the law has been complied with after an examination of all the evidence in relation to such final proof, the state engineer issues a license confirming such use. The date of priority of right under such license is that of filing of application in state engineer's office.

Adjudication of Rights.—The 1903 Idaho statute left the adjudication of water rights to the courts, but provided that actions could be initiated by a water commissioner for the adjudication of rights to the waters of a stream which had been partly adjudicated. It was also provided that whenever a suit to adjudicate rights is filed the court "shall request the state engineer to make an examination of such stream, and the canals and ditches diverting water therefrom, and of all the land being irrigated by such canals and ditches and other works," and the map and report resulting from such examination shall be "accepted as evidence in the determination of such rights by such court."

The provision for the initiation of actions by a water commissioner was declared unconstitutional in Lake v. Budge (75 Pac. 615). In Boise City Irrigation & Land Company v. Stewart (77 Pac. 25) the provision for requesting the state engineer to examine and report upon the physical conditions was held to be merely directory and not mandatory. The preparation of physical data by the state engineer has been so satisfactory, however, that it is certain that the court will request his services in most cases. The costs of his work are apportioned by the court among the parties to the suit, become a lien against the real property in question, and, if necessary, are collected as ordinary taxes.

Distribution of Water.—"For the purpose of administering and controlling the public waters," Idaho is divided into three water divisions with limits fixed by statute. The governor appoints a water commissioner for each division. The three water commissioners and the state engineer compose the state board of irrigation. The board "shall devise all needful rules for the distribution of water." It divides the divisions into water districts for which water masters are elected by the water users of the district.

Utah.

As the first Mormon settlements in Utah were absolutely dependent upon agriculture, and that upon irrigation, the need of legislation regarding water rights was early recognized. The first territorial legislature, in 1852, gave the control of all "water privileges" to the county courts and authorized them to "exercise such powers as in their judgment shall best * * subserve the interests of the settlements in the distribution of water for irrigation or other purposes." The court of Salt Lake County was the only one to act under the statute and it granted water rights, settled disputes in regard thereto and appointed water

masters to distribute water according to decrees. The court at that very early date acted about as the Board of Control does in Wyoming today, and if the other county courts had done likewise there would have been no need of further legislation.

Due to the neglect of the courts, other than that of Salt Lake County, to enforce the law, other legislation was adopted in 1880 and in 1897—the latter following the California statutes. The office of state engineer was also created in 1897 but he had little authority regarding water rights until 1903 when the present statute was adopted.

Acquirement of Rights.—The present system of acquiring water rights in Utah is based on that of Wyoming and Nebraska. The application contains the additional information of "the time during which it (the water) is to be used each year"—that is the right is, or may be, restricted to certain periods within the year. A notice of the application must be published for 30 days in a newspaper of general circulation within the watershed so that a protest may be made to the state engineer by parties claiming prospective injury and thus assist him in determining whether the new appropriation will conflict with existing rights.

The 1903 statute provided for a hearing in case of protests, but in 1904 such a procedure was prohibited by court order. No appeal was taken to the supreme court and the provision was omitted when the law was re-enacted in 1905.

The 1903 statute also authorized the state engineer to reject an application which he deemed detrimental to the public welfare. Following such an action in 1904 the state engineer was reversed by court decree and, again, the case was not appealed and the provision was omitted in the 1905 statute. By an amendment of 1911, the state engineer must approve all applications except where they will conflict with existing rights, or where, after submission of the question to court, the latter decides that the application is not for the most beneficial use of the water. The question of "best beneficial use" and the feasibility of projects is to be answered by data being collected by a Conservation Commission.

By an amendment of 1911 Utah follows the Idaho statutes regarding time of beginning and completing work and application to beneficial use, but the state engineer is authorized, for good cause shown, to extend the five-year and four-year periods to a maximum aggregate allowance of fourteen years from date of approval of application.

Proof of completion of work is made on regular forms, attested by two witnesses, and accompanied by certified detailed maps. The state engineer issues a certificate of appropriation when satisfied that "the appropriation has been effected."

Adjudication of Rights.—Under the system adopted in 1903 the adjudication of rights is initiated by the state engineer making a complete survey of the "river system or water source" and collecting all necessary data. After completion of survey a statement is filed with clerk of district court who mails form for statement of claim to each claimant. The state engineer tabulates the claims and files such with clerk of court. The court may appoint a referee to take further testimony. The decree is rendered by the court based on the maps and data of state engineer, the statements of claims, and the testimony taken before referee. A certificate is issued to each owner in accordance with the decree.

The system has not yet been fairly tried as the surveys and collection of data have not been completed for the first stream chosen—the Weber River. The early work was done on an elaborate scale, and the funds necessary for completion are not available.

Distribution of Water.—The state engineer is authorized to divide the state into water districts and a water commissioner is appointed by the governor for each district from persons recommended by the state engineer. These water commissioners have the same duties as in the states already discussed, the only innovation is that the state has not been divided into large divisions with superintendents in control.

Nevada.

Nevada first legislated regarding water claims in 1866 when it provided for the filing of certificates and plats by intending appropriators. Further legislation was adopted in 1889 and in 1899—the latter being copied after the Wyoming statute, but as the county instead of the state was made the unit nothing was done. In 1903 through the efforts of Senator Newlands who had been probably the foremost leader in securing the passage of the National Reclamation Act of June 17, 1902, the Nevada legislature created the office of state engineer and provided for the definition of water rights and the distribution of water. The influence of the expected benefits of the Reclamation Act on the passage of the 1903 Nevada act is shown by the preamble to the latter, wherein the entire Reclamation Act is recited and in addition many paragraphs presenting the opportunities for irrigation development in Nevada and the need of a determination of rights before national aid could be given.

Acquirement of Rights.—The 1903 statute contained no provision for the acquirement of rights but it was supplemented in 1905 by sections so providing copied from the Wyoming and Nebraska statutes and containing the requirement of publication first adopted in Utah. In 1907 the maximum quantity which could be appropriated for irrigation purposes was fixed at three-acre-feet per acre per year. This maximum annual allowance was changed in 1909 as follows:

> In all parts of the state where water cannot be beneficially used for irrigation for a greater period than six months each year the maximum quantity appropriated for each acre shall not exceed three (3) acre-feet per annum. In all parts of the state where water is beneficially used for irrigation for a period of nine months or more in each year, the maximum quantity of water that may be appropriated shall not exceed three (3) acre-feet for the five months beginning May 15th and extending to October 15th of each year, for each acre of land supplied, and the maximum quantity of water that may be appropriated for each acre during the remainder of each year shall not exceed one-half of one-acre foot multiplied by the number of months of each year other than the five months hereinbefore named, during which water is so beneficially used

Definition of Rights.—The 1903 statute provided a method for defining rights which is still in force and which follows the Wyoming system except that no details of procedure are prescribed. The state engineer

is alone responsible for the work. He makes the surveys, collects the necessary data, tabulates the "proofs of appropriation" submitted by claimants, determines the priority and amount of each claim, and finally issues a certificate to each water right owner. The 1903 act allowed two years after the determination in which aggrieved parties might bring action in the courts, but the time was reduced to one year in 1907.

Distribution of Water.—In 1901 a state board of irrigation consisting of the governor, attorney-general and surveyor-general was created to co-operate with federal bureaus in stream gauging and irrigation investigations. In 1903 the state engineer was made a member and secretary of the board. The board has authority to divide the state "into such water divisions or water districts as seem to it advisable," and may appoint water commissioners to divide the waters of streams according to priorities.

BOOK ON OREGON WATER RIGHTS.

State Engineer Lewis has prepared a pamphlet containing information for water users of the state in connection with adjudication of water rights.

In many instances proceedings have been started by users of water from various streams and tributaries to establish rights for irrigation, power, mining, domestic, stock and other uses.

Upon a final determination of these proceedings a decree is entered in the circuit court defining and establishing all rights. Thereafter certificates are issued by the state which are the basis of title to the water and are recorded as are deeds to land.

The announcement of the State Engineer says:

In many cases water rights were initiated prior to February 24, 1909, which have not yet been completed and the right perfected. The appropriator has a reasonable time after he initiates his water right in which to complete the same, and therefore, the right he has under an appropriation depends upon the diligence which he has exercised in applying the water to the intended use.

There are many cases where the appropriator, prior to the adoption of the water code, had been exercising diligence to complete an appropriation and where a reasonable time for the completion of the same has not yet elapsed. Such uncompleted rights should receive the same consideration as those which were perfected, when the question of unreasonable delay and lack of diligence does not arise.

The question of diligence depends upon the surrounding circumstances, but in any event, the right to water for the irrigation of lands not irrigated is confined to comparatively recent appropriations.

The older the date of priority claimed, the more difficult it becomes for the claimant to show due diligence in the application of the water within a reasonable time after the initiation of his right, if he is claiming a right to irrigate lands not irrigated at the present time under such old right.

The fact that additional lands not now irrigated may be irrigated from the same ditch through which lands are irrigated under an old right, does not give the appropriator a right to irrigate those lands

His right is confined to the lands actually irrigated by him under the old right, and the application of water to such additional lands not now irrigated when a number of years have elapsed since the right was initiated, can only be made by virtue of an enlargement of such old right or the initiation of a new right, and in either case, the right to irrigate such additional lands will date from the time the proper steps were taken to bring such additional lands under irrigation, either under such enlargement or by the initiation of a new right.

ALTERNATING CURRENT BLOCK SIGNALING[1]

BY J. B. STRUBLE.

When electric railway transportation had been developed to the point where automatic means were required for spacing the trains, the art of signaling was confronted with a new problem. The old method of controlling the indications of signals along the right of way by direct current rail curcuits was no longer available because the rails were required as return conductors for the train propulsion current. Being thus ousted without so much as an apology from its time-honored proprietorship in the rails as electric conductors, the railway signal world found itself suddenly deprived of its greatest asset and left to work out its own salvation as best it could.

Rail circuit control being the only known means whereby a train would reliably and automatically protect itself, the problem was to get back to the rails and accomplish two things, apply to and confine within the rails of the insulated section, or block a current distinctive in character from that of the propulsion current and provide means for the uninterrupted flow of such propulsion current.

A further problem was to obtain some form of relay or translating device which could be connected across the rails at one end of the track circuit and, while being operatively immune to the propulsion current, would operate due to the presence or absence of the distinctive signaling current in the track rails to control a signal.

Such a system first appeared in 1901 and up to the present time the only changes have been of a detail nature.

It may be of interest to note as an incident typical of the enterprise of the Pacific Coast, that in 1902 the then North Shore Railroad sent an engineer East to purchase material for electrifying the road, and when he came back he had the equipment and a signal system to protect it. At that time the a.c. signal system existed largely on paper, but he took it on faith with the result that the following year the first installation came into existence and it continues to give excellent service at the present time.

With the above outline in mind it will be seen that a.c. signaling was originated for a definite and specific purpose, that of continuing to control signals by track circuits after the advent of the electric propulsion of trains in which the rails were commandered as a part of the propulsion system. As will be shown later, the a.c. track circuit and its related apparatus may assume a variety of forms according to the track conditions to be met, and as to whether the propulsion current is direct or alternating.

The type of, and operating power for the signal itself, is in no way determined by the a.c. track circuit except in an incidental way.

The impedance of rails to alternating current is a subject of special interest because of the effect of the magnetic field set up in the steel. Apparently this field causes the current to flow along the surface of the rail instead of uniformly through the whole cross

[1]Paper to be presented before San Francisco Section, A. I. E. E., May 24, 1912.

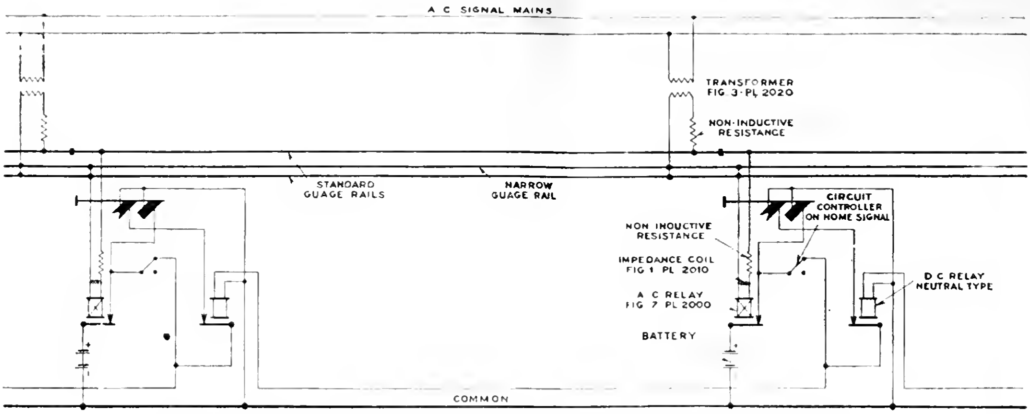
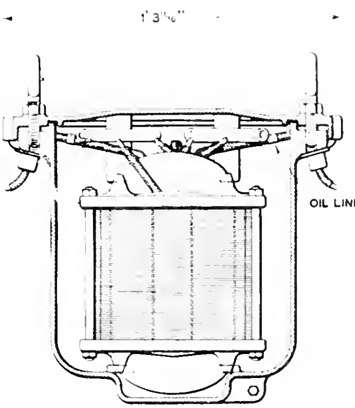


Diagram of Block Signal Circuits and Apparatus Used on North Shore Railroad.

section, a conclusion based upon the fact that with a rail bonded to capacity, the impedance to twenty-five cycle, alternating current amounts to several times that to direct current, and to sixty cycle current, proportionately higher, whereas the power factor is sometimes as high as seventy or eighty per cent. The presence of direct current lowers the impedance of the rail to alternating current.



Transformer, Open Magnetic Circuit Type.

Let us insulate a stretch of say 2000 ft. of a track, and within these limits connect across the two rails of the track at one end, the secondary of a transformer. Connect in series with this secondary an ohmic resistance to prevent a dead short circuit on the transformer when the track is occupied by a train.

Connect across the rails at the other end the winding of a track relay provided with an aluminum vane moving between pole pieces equipped with shading bands. Such a relay will not respond to direct current but will respond to alternating current. The contacts carried on its moving element in turn control the signal operating on other circuit.

With no train in the block the relay is energized (and its contacts closed) by current from the transformer flowing over the insulated rails which thus constitute the sides or conductors of the circuit.

A pair of wheels within this territory will shunt the relay and gravity will open its contacts, thus resulting in a stop signal indication.

This arrangement will operate satisfactorily for a steam train, and remove from the signal system the disturbing influence of foreign leakage current, as from a neighboring trolley line, which is sometimes so annoying with direct current track circuits; but for an electric train, which we will assume uses direct current, certain changes and additions are necessary to the a.c. track circuit apparatus thus far described.

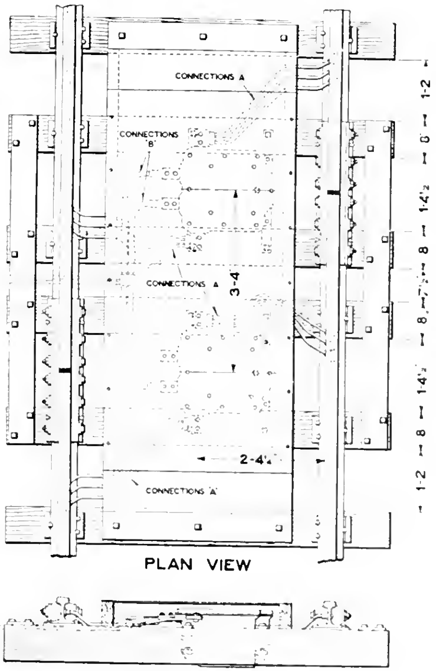
One of the rails is used as a continuous return conductor for the propulsion current, while the other is insulated into sections or blocks for signaling purposes.

Due to the presence of propulsion current in the continuous rail, a drop in d.c. voltage in that portion of it which is opposite the insulated section will cause d.c. to flow through the block rail via the transformer secondary at one end, and the relay winding at the other.

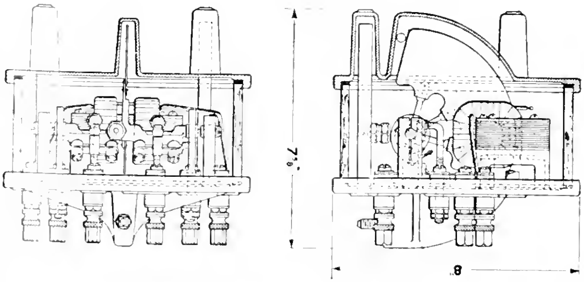
The effect of this d.c. might be sufficient to saturate the iron of both, so that the a.c. would be ineffective to operate the relay.

To avoid this result on the transformer, its magnetic circuit is provided with a small air gap which prevents saturation, and in addition the ohmic resistance, which is connected in series with the track secondary restricts the amount of disturbing direct current and in addition prevents excessive short circuit current, thus performing a two fold duty. Between the relay and the rails at the other end of the track circuit is inserted an ohmic resistance which restricts the amount of direct current while not seriously interfering with the flow of alternating current.

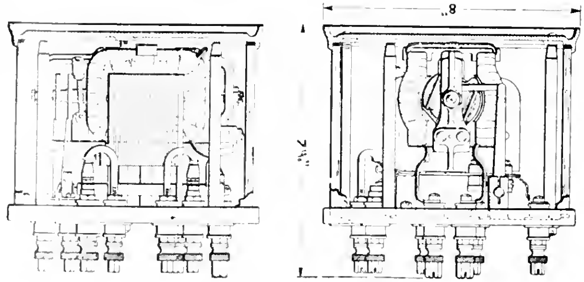
In addition to this protection there is connected across the relay coil terminals a reactance having low ohmic resistance compared to that of the relay coil, and an air gap in its magnetic circuit to prevent saturation by direct current. This device provides an electrical sieve or strainer whereby direct current is



Application of Inductive Type Bond



A. C. Relay, Vane Type, Single Winding.



A. C. Relay, Wire Wound Armature Type.

kept out of, while compelling alternating current to pass through, the relay.

This arrangement of track circuit and its related apparatus is known as the single rail return system. It is advantageous where the track arrangement is complicated with many switches and frogs, where the track circuits are short or where other considerations make the loss of one of the track rails as conductor of the train propulsion current of relatively small importance.

The operative limit of length of this type of track circuit is determined chiefly by two factors, that of the amount of insulation resistance between rails and that of propulsion voltage drop in the return rail. If the latter is considerable in amount, it must be met by more resistance between the transformer and the rails and between the relay and the rails.

In order to supply the relay with sufficient energy, this in turn requires a higher a.c. voltage across the rails, and, of course, a still higher secondary voltage at the transformer. If, in combination with this, there is a low ohmic leakage resistance between rails, due to wet saline or metallic ballast much in contact with the rails, the amount of a.c. energy necessary to maintain this higher voltage will be considerable.

As good electrical engineering calls for a moderate propulsion drop in the rails and as good track engineering calls for well drained, well ballasted track, the two happily work in harmony in favor of a long track circuit, so that the length of a single rail track circuit may ordinarily exceed that required by the distance between signals. A number of installations using the single rail type of track circuit are at present in service, perhaps the most notable one being that of the Interboro Rapid Transit in New York City.

In the double rail return system both rails of a track are insulated to form sections or blocks and both rails serve at the same time as return conductors for the propulsion current. This is accomplished by connecting across the rails at each end of the section an inductive cross bond consisting of a few turns of heavy copper conductor around an iron core provided with an open magnetic circuit. From the middle point of these turns a tap is brought out which connects with a similar tap on the inductive bond of the adjacent section.

Propulsion current therefore flows in opposite directions through each half of the bond, so that its magnetizing effect is neutralized so long as it divides evenly, while to the signaling current all of the turns act in series to inductively oppose the flow from rail to rail, thus causing a difference of a.c. potential between the rails to operate the track relay.

As both rails of a track do not in practice conduct equal amounts of propulsion current, the difference, known as unbalanced current, is effective to magnetize the inductive bond, and if not provided with an air gap, might saturate it to the extent of reducing its reactance to the signaling current and thus produce a stop signal indication. The unbalanced capacity of the bond, which is determined by the amount of the air gap, is adjusted sufficient to meet the requirements of a properly bonded track, and if a signal failure should occur due to excessive unbalancing current, that fact is a useful indication that the bonding needs attention.

The iron is worked so far down on the saturation curve that the impedance actually rises with a small (let us say normal) amount of unbalancing, and the unbalancing capacity rating is taken at that point where the increased amount of unbalancing current reduces the bonds impedance to that when no unbalancing current is present. Not to mention the loss in propulsion power implied by a high unbalancing capacity of the bond, it means a higher first cost and a higher cost of operation for the signal system because a large air gap in the bond means more a.c. power to maintain between the rails the relay operating potential, in turn causing more a.c. drop in the rails, more leakage current, larger track transformers, more copper in the supply mains, larger sources of power supply and more power.

Unlike the single rail return system, the length of a double rail track circuit is in no way affected by the amount of propulsion voltage drop in the rails, so that a low voltage track circuit is possible and desirable for several reasons. The inductive bonds require less charging current, there is less a.c. drop in the rails, less leakage loss and a saving all the way back to the source of power.

To further increase these advantages a track relay is used which requires that only a small part of its torque-producing energy shall come from the track rails, the larger part coming direct from the transformer. Such a relay may take a variety of forms among which are the galvanometer and polyphase, but the main feature is that torque is produced only when current is present in both windings and in certain phase relations.

Torque being proportional to the product of the magnetic fluxes produced by the two windings, it follows that the fluxes produced by a small amount of energy from the track rails with a larger amount of energy from a direct source will operate a track relay with a very small amount of energy from the rails.

This type of track relay has recently been developed to such an extent as to make it possible to operate a track circuit of moderate length under track leakage conditions so unusual that all former attempts to operate a track circuit of any kind had to be abandoned.

When alternating current of a given frequency is used to propel the trains a current of higher frequency is used for operating the signals, the factor of frequency constituting the distinctive character of the signaling current. The track relay in this case responds to current of one frequency, that of the signaling current, and does not respond to that of the propulsion current nor to direct current.

One interesting type of relay used in this connection is that of a miniature induction motor, the rotor of which has a vertical shaft supported in ball bearings. The speed of the motor being proportional to the frequency, it follows that selection is secured through the medium of a contact operating centrifugal device driven by the motor. This centrifugal device is so adjusted that the contacts are closed at the speed produced by the frequency of the signaling current only.

The relay is interesting in the further respect that the contacts are held closed without the expenditure of work, for here we have force or pressure but not distance. The energy consumed is only that required to overcome the bearing and wind friction, and if these could be eliminated we would come very near having something for nothing.

The unbalancing current in the inductive bonds for a.c. propulsion is small compared to that with d.c. propulsion, because the total amount of current in the rails is so much less, and for the further reason that the ohmic resistance, as when caused by defective bonds, is but a small part of the total impedance of the rails to the a.c. propulsion current.

The inductive bonds may therefore be built with a closed magnetic circuit, thus reducing the amount of signaling current. The effect of unbalanced current is to produce a voltage between rails, but as this is of the frequency of the propulsion current the track relay does not respond to it.

We have seen that one of the purposes of the ohmic resistance between the track and the transformer, in the single rail scheme for d.c. roads is to restrict the amount of d.c. through the transformer. With the double rail scheme for d.c. or a.c. roads there is a very small difference of propulsion potential between the rails so that the ohmic resistance between transformer and track may be replaced with a reactance coil having an adjustable opening in its magnetic circuit. This reactance saves most of the energy which is lost in the resistance and besides it provides a means for adjusting the phase of the track current which supplies one winding of the track relay, with relation to the phase of the current in the other winding of the track relay, which latter is supplied directly by the transformer, to give the maximum torque in the relay.

Another arrangement is to use neither resistance nor reactance but to provide instead an adjustable amount of magnetic leakage within the transformer itself. This scheme is to simply adapt poor regulation to a useful purpose, for as the current rises, due to a train short circuiting the track, the voltage drops, thus limiting the output.

The track transformers receive their power from a pair of a.c. mains extending over the signaled territory. These mains carry current at a potential of 2200 volts as a rule, with a frequency of preferably 25 cycles. The voltage of the track secondary varies anywhere from two to ten according to the conditions to be met (the relay operates on a few tenths of a volt to three or four volts), and the power taken by a track circuit anywhere from a few watts up to one or two hundred. The leakage resistance from rail to rail, per thousand feet of track, is usually assumed at six ohms, although cases are known as low as .06 ohms and as high as several hundreds ohms. For any given track circuit this varies with wet and dry weather. The power factor of a track circuit and its apparatus is about sixty or seventy per cent.

Block signals were usually lighted by oil and operated by a series motor taking current from a local primary or secondary battery. With power available in the signal mains for track circuit purposes, a sec-

ondary coil of 110 volts was added to the track transformer for lighting and operating the signal with alternating current. This change dispensed with the lamp man and his supplies; provided a better and more reliable light with no smoke and soot to dim it; a contactless induction motor took the place of the d.c. motor with its commutator and brushes, and the battery with its fluctuating voltages, temperature troubles, renewal expenses and labor charges, was thrown out.

Alternating current signaling came primarily to meet the necessities of electric roads. The very existence of these roads made its use necessary to the signaling of steam roads in localities where stray currents from the electric road got into the battery fed track circuit of the latter, making necessary the use of the distinctive current idea of selection. Steam trunk lines are adopting a.c. signaling because its low maintenance soon overtakes the higher initial cost, and because of the superior service obtained.

A number of a.c. signal installations have been applied on steam roads in which the signal apparatus is adapted to work without change when the road is electrified. One such plant was installed with apparatus adapted to final a.c. propulsion, although at that time steam trains used the track and at the present time the road uses direct current for running its trains. The signals work equally well for any kind of train propulsion.

Alternating current signaling is rapidly coming into use for steam roads in desert regions where there is at present no foreign current to give trouble to a battery track circuit, but the system will be prepared for such trouble should it arise; it will be readily adaptable to electrification, should that come, and it justifies its use on the grounds of economy and high class service.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION.

Messrs. Levy, Hanbridge and Wolden, the Power Company Committee of San Francisco Local No. 1, California State Association of Electrical Contractors, gave a dinner last Monday to Geo. Holberton, of the Pacific Gas & Electric Company, Messrs. Bullard, Wise and Nieman of the Great Western Power Company, and Mr. R. M. Searles of Rochester, N. Y. The object of the dinner was to carry out one of the objects of the California State Association—"closer co-operation between central stations and contractors," and to find out from Mr. Searles the manner in which such things were handled in the East.

In his easy style, Mr. Searles briefly outlined how the central station and contractor were co-operating in Rochester, and explained how it worked to the advantage of both sides. He was listened to carefully by all concerned, and many questions were asked in order to see if the same methods could not be carried out here.

Mr. Holberton and Mr. Bullard each spoke briefly and expressed a desire to co-operate more closely with the contractor.

In a general discussion, taken part in by all, it was decided that the dinners be continued and held at regular times, and all the contractors be invited to same with the idea of hearing from all sides.

After spending two hours in talking over their troubles and ways to correct same, it was decided to hold another meeting Friday, May 24th, as guests of A. W. Bullard, vice-president and general manager of the Great Western Power Company.

The secretary of the State Association feels that a great deal of good is going to be the result of these meetings, and he wants every contractor to show the same spirit that is being shown by the representatives of the central station. Let us get together and show these gentlemen that we desire their co-operation by assisting them by boosting and advancing their interests wherever possible.

The arrangements are fast going ahead for the State Convention of the Contractors, to be held in San Jose July 24, 25, 26, 27. A liberal subscription has been guaranteed from the business men of San Jose to help entertain the visitors. A good time is promised everyone who attends the convention, and in order to make everyone feel at home, visitors will be well taken care of for the first two days during the executive meeting of the contractors and the last two days are to be devoted to the good of the business, which will be conducted in open meeting, morning and afternoon, where interesting papers will be read in reference to different branches of the business. The annual dinner will take place in the evening.

Saturday, July 27th, the contractors will have one of their annual electric trades' days that have been so successful in the past.

Thursday night, July 25th, the entire proceeding, with the use of the hall, etc., will be turned over to Statesman Sanderson of the Sons of Jove, and he will be expected to put California on the Jovian map. The ladies will be taken care of in a body at a theater party.

Last, but not least, we are endeavoring, and I feel sure that by the time this data is in your hands, arrangements will have been completed so that a special rate will be given from all points in California to San Jose.

Now, fellows, all together, whether you are a manufacturer, jobber, contractor, or central station manager, start in laying your plans so that yourself and as many of your employes as possible, with their families, can have their vacation with the contractors in San Jose during the fourth week in July and help a good cause along.

Frank Watts, general manager of the McFell Electric Company, is confined to his home in Burlingame after undergoing an operation for appendicitis. At last reports he was doing nicely.

Paul Butte and H. A. Reed, who have been handling a labor scrap in Portland, have returned to this city, having straightened out their difficulties in the northern city.

Joe Endert, an electrical constractor in Bakersfield, reports that they have labor troubles.

Carl Heibron, manager of the Southern Electric Company of San Diego, reports business as good in the southern city.

A STEAM TURBINE MONUMENT.

The General Electric Company has re-erected in the centre of a park plot in its grounds at Schenectady, N. Y., the first 5000 kw. Curtis steam turbine installed in the Fisk Street Station of the Commonwealth Edison Company at Chicago. It is to serve as a memorial to the rapid development of the steam turbine unit applied to central station service. This turbine was installed in the Fisk Street Station eight years ago, being put in operation on October 2, 1903, and remained in continuous service until May 29, 1909. It was specified in the contract by President Insull when this unit was replaced that it should be set up as a monument to commemorate the great step in engineering which its installation marked. A bronze tablet detailing its history has been placed on the turbine.

DRAFTING ROOM PRACTICE, III.

BY A. L. MENZIN.

It is not always possible to give a complete description of a structure by showing exterior views alone. These must often be supplemented by sectional views which show what would be the appearance if certain parts of the structure were cut away. When such sectional views are shown, it is generally desirable to distinguish surfaces which actually exist from those which are laid bare to show the interior construction. Also, when the structure is built up of different materials, it is desirable to represent the different materials in different ways. For these purposes what is known as cross hatching, or section lining, is commonly used.

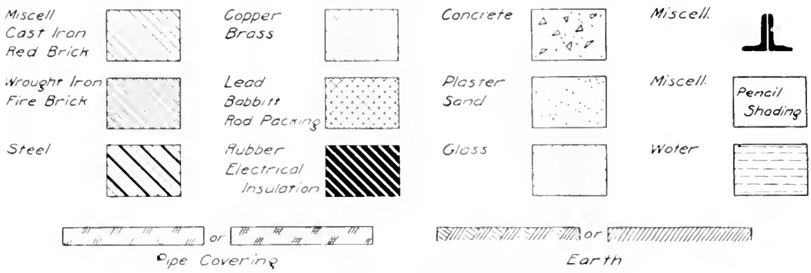


Fig. 1. Conventional Cross Hatchings.

Fig. 1 shows some conventional hatchings for representing the materials most often employed. Those marked "Miscell." are commonly used to represent any material in section; although, when the drawing shows sections of different materials, it is advisable to cross-hatch them differently, especially if the drawing is illustrative.

When drawing those hatchings which consist of parallel lines, care should be taken to space the lines at equal distances apart. Besides the spring dividers, several mechanical aids have been devised to make this possible, but the draftsman will ordinarily space the lines by eye.

The lines should be no closer together than is necessary to make a good appearance for the closer the lines the longer it will take to cover a given area. A cross hatched surface looks well when the lines make an angle of 45 degrees with a straight outline of the section, assuming that it has one.

The solid black section shown in the upper right-hand corner of Fig. 1 is much used on illustrated drawings. As a rule, it should not be used on working drawings on account of possible alterations in the future, since a solid black section is very difficult to erase. Solid black sections can be made quickly by first drawing heavy outlines and then filling in with a fine camel's hair brush. If a brush is not available, a coarse pen will do. When the section includes more than one part, a distinct white line should be left between them to make the construction clear.

Solid pencil shading is much used, not only to represent sections, but also to give prominence to exterior surfaces of special objects. Piping and foundations are frequently shaded in this way. The shading is done with a soft pencil, such as an HB, on the dull side of the tracing cloth. The shading should not be too black.

Fig. 2 is an example of the use of cross hatchings for distinguishing different parts of a complex structure and for indicating the materials of which they are made. In terms of the conventions specified in Fig. 1, the rod is shown to be of steel, the stuffing box of cast iron, and the gland and nut of brass—all of which is distinguished from that which represents the packing. Cross hatchings are not intended to specify the actual materials of which parts are made, but are used

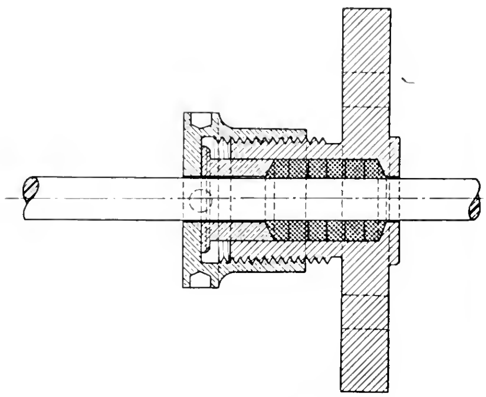


Fig. 2. Use of Cross Hatchings.

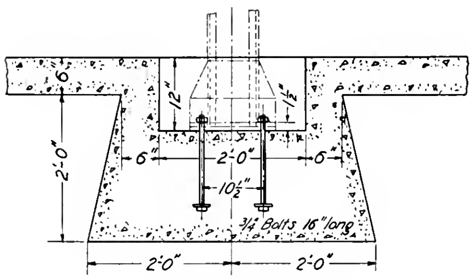


Fig. 3. Open Cross Hatchings.

in an illustrative sense only. The name of the material of which a part is to be made should be specified on the detail drawing.

Fig. 3 is illustrative of how a cross section can be shown so as to leave space for putting on dimensions. When a section is large this method is often employed, for it would be a waste of time to cross hatch the entire surface.

Drawings showing timber construction lack clearness and look very flat unless the ends of timbers shown full are distinguished in some way. This is usually done by imitating the annual rings and radial cracks which are usually visible on a cross-section

Fig. 4. Timber Sections.

of a log. The first sketch in Fig. 4 represents a log or pile, while the other sketches are illustrative of the diversified manner in which the ends of sawed timber may be shown. Since boards are cut from different sections of a log, the center of the log may be assumed at different points and the annual rings drawn accordingly. For this class of work a Gillott's crow quill pen is especially suited.

Of the details that are most frequently drawn, screw threads form a large part. A and B of Fig. 5 show the usual ways of representing ordinary machine and pipe threads. The first is an imitation of the V-thread while the other is purely conventional.

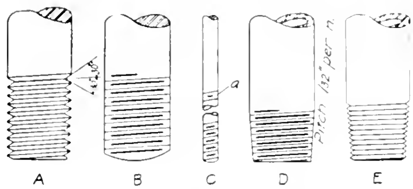


Fig. 5. Conventional Screw Threads

When space permits, the pitch of the threads as represented should equal the actual pitch which the part should have and the depth of threads should also approximately equal the actual depth. This rule cannot be followed when drawing small screws such as C. The common practice is to draw the lines representing the threads as close together as can be done without giving them a crowded appearance. However, the depth of threads shown should about equal the actual depth and not the depth corresponding to the spacing of lines. The latter construction would give the screw a weak and unworkmanlike appearance, as at "A."

Pipe threads used by American manufacturers are in accordance with the Briggs standard. Pipe threads are made to a standard taper of 3/4-in. per foot of length which is equivalent to a taper of 1/32 in. per inch with reference to the center line of the pipe. Data on pipe threads are not given in many handbooks where one would expect to find them, and are therefore given below.

To make it possible to use the same taps and dies for different kinds of pipe, manufacturers make stand-

American or Briggs Standard for Pipe Threads.

Nominal Size.	Actual Outside Diameter.	Number of Threads per Inch.	Length of Perfect Thread.
1/8	.405	27	.19
1/4	.540	18	.29
3/8	.675	18	,30
1/2	.840	14	.39
3/4	1.050	14	.40
1	1.315	11 1/2	.51
1 1/4	1 660	11 1/2	.54
1 1/2	1.900	11 1/2	.55
2	2.375	11 1/2	58
2 1/2	2.875	8	.89
3	3 500	8	.95
3 1/2	4.000	8	1.00
4	4.500	8	1.05
4 1/2	5.000	8	1.10
5	5.563	8	1.16
6	6,625	8	1 26
7	7.625	8	1.36
8	8,625	8	1.46
9	9.625	8	1.57
10	10.750	8	1.68
12	12.750	8	1.87

Taper=3/4 inch per foot.

ard, extra strong and double extra strong steel and wrought iron pipe as well as copper and brass tubing so that the external diameter corresponding to a given nominal size is the same in each case. The internal diameter varies with the thickness.

Referring again to Fig. 5, D shows the conventional way of representing a pipe thread. E is a much neater and more suggestive way. When drawing a V-thread, such as A and E, the sides of the V's should each make an angle of 30 degrees with the lines representing the threads. Otherwise, the lines joining the points of the V's will not be parallel.

WASHINGTON WATER CODE.

Considerable interest has been awakened by the action of Governor Hay, of Washington, in calling together representative men from all parts of the state who are, by virtue of their business, thrown into almost daily contact with the operation of the existing water laws. This body of men met last month in Spokane, and a committee of fifteen was appointed to draw up a new code.

GOOD ROAD SIGNS AT PORTLAND CONVENTION.

Good roads held the center of interest in Portland recently. Here are some of the signs that attracted attention:

"Bad roads lead to the poor house."

"Stuck in the mud? Get out by signing the good roads petitions."

"Bad roads are a luxury no State can afford."

"Good roads mean a lower cost of living. Sign the good roads petitions."

"Good roads are the lungs of a healthy State. Make our State healthy."

"Boost for better roads, prosperity, people and progress."

"Good roads are worth good dollars to Oregon."

"Everybody helps pay the mud tax and gets nothing in return."

"Portland Ad Club absolutely in favor of good roads."

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Retirement of Mr. Weaver

In this day and age of centralization of human interest and endeavor, the individuals making up the concentrated effort of our great corporations vanish from public notice as such. As the waters of our Western streams bound and rollick from their mountain strongholds, each possessing a beauty and individually tantalizing and ceaseless in its ever changing panoramic scenery, eventually blend their combined characteristics in the splendor and grandeur of the full-grown, power-driving river, so human individuality to a measure fades away when the modern corporation with its hundreds of pulsating breasts, puts forth a united effort to accomplish a given task. In life, however, there are some personalities so strong, so towering above the usual run, even when compared with the best, that their influence though unnamed and unheralded, like the dark planets of the heavens, exert in a powerful manner their unseen force in the evolution of human affairs.

Announcement comes from New York of the retirement of W. D. Weaver, editor of the Electrical World. For the past nineteen years Mr. Weaver's influence upon the upbuilding of all that is good and true in technical journalism in affairs electrical, has been so marked and yet so quiet and unassuming, the Journal feels it would be untrue to its ambitions—that of conscientiously endeavoring to aid and promote the conversion, transmission and distribution of energy—if we failed to utter a word of sincere regret over the retirement of Mr. Weaver and at the same time to express the heartiest of good wishes for his uture happiness and success in his new endeavors.

Life is so brief, so transient, so fleeting—we scarcely have time to greet our daily acquaintances unless it be, as it often is, to say good-bye to them in a place where the poet has said "the sun across the mournful marble plays." To the editorial hand which though enshrouded from public view, disseminates knowledge and ideas for good throughout the entire technical world, the deepest debts are due, and when that hand writes with force that moves men to thought and action, as is true in Mr. Weaver's masterly stroke, retirement is keenly felt.

Indeed as the western Indian cries in the wilds of the Rocky Mountains when far from home "Injun no lost—tepee lost," so Mr. Weaver with his world of technical knowledge can never be lost with this ever-present companion, but those of us still dwelling in the tepee of technical journalism will feel lost without him.

Good Wages Good Service Good Dividends

Deliver the goods—good service, good wages, good dividends—should be the cry of croporation leaders and regulating commissions alike. On another page of this Journal is to be found an account of the recent activities of the American Electric Railway Association and the American Electric Railway Manufacturers' Association in Los Angeles, San Francisco and other western cities. The frank discussion of vital points at issue in public utility regulation has proved of considerable profit and the executive officers of these associations now making a tour of the United States are deserving of much credit for their candid and public spirited attitude in

bringing frankly before the American people the crucial points at issue.

Oscar D. Crosby in a fascinating manner, before those attending the recent, well appointed banquet at the Palace Hotel in San Francisco given in honor of the executives above referred to, presented forceful arguments calling attention to the six parties concerned in commission regulation—the promoter, the banker, the broker, the investor, the operating managers and the wage-earners. It would seem that the promoter, the man with an idea, should be justly compensated. The investor who as a rule is ultimately the person of meager means in life's natural wealth should be borne in mind when determining a rate. In the ideal undoubtedly a fair return would be such that we would advise those nearest and dearest to us to invest their money all risks carefully considered and weighed. While it is "cousin Mary's money" which ultimately furnishes the great wherewithal for public utility financial support, and as such it must be protected, we must not forget, in justice to the public, that "cousin Edward" on the board of directors too often in the past has proven that he would knowingly descend so low as to freeze out all comers irrespective of their relationship or methods.

To make commission regulation a success it is supremely evident that two ruling features must predominate. First the personnel of the commission must be beyond reproach, being free from entanglements of both parties to the issue, and again the power of the commission, while in the broader sense fixing rates, regulating adequacy and extension of service and passing upon bonding proportions, should not be exerted in actually performing details of management in these great utility corporations.

It is imperative that three predominating evils or wrong viewpoints be adjusted at once on the part of the public or stagnation and even possible chaos and dissolution may result to our great electric transportation companies of America. In view of the fact that in the twenty-five years of electric traction life, half of the 70 or 80 companies operating in Massachusetts where commission regulation from the beginning has prevented any watering of the stock, have nevertheless proved non-dividend paying and the average dividend of all American electron traction companies is only 5½ per cent, if the rate of earning on securities of this sort is to be limited in the future to even 6 per cent the industry is dead and money will be diverted into more profitable and less dangerous channels. Again the continual extension of the 5c fare limit with its ever increasing transfer range, like Mrs. Wiggs' soup, is adding much water with no additional nutriment wherewith to pay dividends. Finally, the franchise question is most vital. No financial institution can reasonably be expected to be induced to supply funds on a 20-year franchise proposition. The indeterminate franchise of Wisconsin seems to be working out with satisfaction and here is a possible solution.

In consideration of the fact that many other channels are open for diverting huge outlays of money, offering large legitimate returns without unjust hamperings and continual challenges of fair play it is evident that fluid money, if unjustly treated, may perhaps follow the time-honored law of least resistance and leave high and dry one of America's youngest yet most promising industries.

The Golden Poppy Special

The Golden Poppy Special to the Seattle convention of the National Electric Light Association, June 10-14, is deserving of the support and enthusiasm that is being manifested on all sides. This eight-car train de luxe, consisting of five standard Pullman sleepers, observation, diner and baggage car, will leave San Francisco for the northern city, Saturday evening, June 8th. A pleasant and profitable outing is in store for all who join the electrified bunch of California boosters in making this trip.

The bridal month of June usually finds Seattle and its surroundings at their best. The men of the northwest have built great cities and built them well. It is an education in itself to see their energy. The building of great hydroelectric enterprises composes no insignificant part of the doings of this section of our country.

To that great class of men in our engineering fraternity for mental food the program of the convention appearing on another page of this Journal will be found interesting and instructive. As is noted the program proper is divided into four main sections—commercial, accounting, technical and power transmission.

In recent years the electric lighting industry has assumed enormous proportions. For instance from the statistics compiled by Director Durand of the Census Bureau, it is found that while the number of arc lamps manufactured increased from 158,187 in 1899 to 195,157 in 1904, and then decreased to 123,543 in 1909, the history of the incandescent lamp and lighting industry tells a far different story. Thus we read that the total value of this latter group increased from \$3,515,000 in 1899 to \$6,953,000 in 1904 and \$15,715,000 in 1909. Hand in hand with this phenomenal growth, the value of lighting fixtures has advanced from \$3,751,000 in 1899 to \$3,295,000 in 1904 and \$6,128,000 in 1909 which, when all gas and electric combination fixtures are totaled, reaches the enormous proportions of \$12,884,000 in 1909.

The varied and countless allied industries brought to life and nourished by this child of recent creation constitute the network of intricacies which the great National Electric Light Association endeavors to promote and father. As some one has recently said when one dollar starts to rolling twenty are set in motion before it runs its course. A body of men of the highest ethical principles and commercial far-sightedness compose the backbone of the great gathering soon be assemble in Seattle. Let all then, in the sunny clime of California who are interested in furthering a worthy cause and who want to demonstrate the old adage of casting your bread upon the waters lay aside for ten days the worries and cares of the office and join the crusade to the north on June 8th in the Golden Poppy Special

PERSONALS.

W. L. Dyer, an electrical engineer of New York, is at Los Angeles.

Robert Edwards, a consulting engineer of Portland, is at San Francisco.

F. F. Skeel, manager of the Crouse-Hinds Company, is at San Francisco.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is visiting his Southern California office.

Tracey E. Bibbins, local manager of the General Electric Company's San Francisco office, is in the East visiting the factories.

A. E. Wishon, assistant general manager of the San Joaquin Light and Power Corporation, was a recent San Francisco visitor.

A. E. Garland, factory representative of Fairbanks, Morse & Co. for Western territory, is visiting the branch house of the firm at San Francisco.

S. J. Keese, manager of the Los Angeles office of the Westinghouse Electric and Manufacturing Company, spent the past week at San Francisco.

L. B. Young, superintendent of the Seattle water department, has been appointed chairman of the board of public works, to succeed A. L. Valentine.

W. H. Crawford, manager of the Portland office of Chas. C. Moore & Company, is visiting the factory of the Babcock & Wilcox Company at Barberton, Ohio.

E. G. Williams, construction engineer of J. G. White & Company, is at New York, after spending the past month in California, inspecting the work in progress at various points.

Paul A. Sinsheimer, formerly financial news editor of the San Francisco Call, has resigned to accept a position as financial underwriter with the California State Railroad Commission.

H. F. Jackson, vice-president of the Coast Valleys Gas & Electric Company, has been visiting Salinas and Monterey on an inspection tour of the new extension of the electric transmission system.

Herman Schifflin, manager of the rock-crushing and cement department of the Allis-Chalmers Company of Milwaukee, has been spending a few days at the San Francisco office of the company.

Chester H. Pennoyer, manager of the National Conduit and Cable Company of California, representing the National Brass and Copper Tube Company, recently returned to San Francisco from Portland.

L. F. Harza, consulting, designing and supervising engineer for several years past with Daniel W. Meade of Chicago and Madison, Wis., has opened offices in the Lewis building at Portland, Ore.

G. Chester Noble, hydro-electric testing expert for the Pacific Gas & Electric Company, has returned to San Francisco from Colgate, where he has been compiling important test data for the company.

Adrian Tobias, the meter expert of the Westinghouse Electric and Manufacturing Company's works at East Pittsburg, spent the past week at the San Francisco office instructing the company's salesmen in the fine points of meters.

J. P. Jollyman, electrical engineer with the Pacific Gas & Electric Company, is at Sacramento in connection with rushing to completion the new River Station. The boilers are being erected and transformers installed while the building is nearing completion. The entire plant will probably be completed by the end of August.

Jos. N. Le Conte has been appointed by the Board of Regents professor of engineering mechanics at the University of California. In his new duties, Mr. Le Conte will take over the time-honored course in analytical mechanics from the physics department. The change has been made largely at the request of the graduate engineers of the University.

O. C. Pratt, president of the Indian Valley Electric Light & Power Company, has returned to San Francisco from Greenville after visiting the Seneca district on the North Fork of the Feather River, where development work has been inaugurated. The first generating unit of 2000 h.p. will be installed by October 1st, and a revival of mining in the Greenville district is expected as soon as there is plenty of electric power.

F. G. Baum, consulting engineer, and **P. M. Downing**, engineer of operation and maintenance, have returned to San Francisco from a valley trip in connection with a proposed one hundred mile extension of the Pacific Gas & Electric Company's hydroelectric system. A steel-tower transmission line, starting from the North Tower at Carquinez Straits and extending in a northerly direction to the town of Nicolaus, in the Sacramento Valley, is being planned by the company's engineers.

The electrical and mechanical engineering students who were graduated during the past week from the University of California at Berkeley with the degree of B. S. were: Edwin Allen Abeel, William Harry Archer, James Alexander Arnott, Ulysses Sheldon Attix, David LeRoy Babcock, James Byers Black, Arthur Franklin Bridge, David Locke Clement, Russell Henry Cooley, William Paul Custer, Frank Charles, Czarnecki, Alfred Victor Guillou, William Simcoe Heger, Jr., Frederick William Jacobs, Roy Philip Lutzi, Stephen Malatesta, Bernhard Martin Mehl, Robert Wallace Mueller, Hikoichi Nakatsu, George Edward Noyes, Chesley Ellis Osborn, James Frederick Pollard, Lester Seward Ready, Robert Reid, Robert Weir Ryder, Horace Earl Sandoval, George Metcalfe Simonson, Earl Alfred Slater, Charles Morgan Smith, Charles Carroll Snyder, Emil W. Taylor, Walter Samuel Van Winkle, James Edwin Wallace, Edward Louis Watts, George Jenner Wheat, William David Wolfe, John Philip Zipf.

MEETING NOTICES.

The next meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held on May 24, 1912, in the Merchants' Exchange Building, California and Montgomery streets. J. S. Hobson will present a paper on "Railway Signaling," J. B. Struble on "Alternating Current Automatic Block Signaling," and P. J. Ost on "Electric Interlocking Systems." A large number of lantern slides will be used for illustrating purposes.

The Electrical Supply Jobbers' Association will meet at Del Monte, May 30, 31 and June 1. The regular golf tournament will be played.

The first annual sales conference of the Northern Electric & Manufacturing Company, Limited, was held at the Vancouver Hotel, Vancouver, B. C., on April 22, 23 and 24. They were honored with the presence of several representatives of leading manufacturers in the electrical line, among them H. E. Sanderson of the Bryant-Perkins Co., E. G. Mack, manager of the Crouse Hinds Company of Canada, C. A. Howe of the Holophane Company, E. B. Pike of the Tungstolier Company of Canada, Robert Kuhn of the American Electric Heater Company, W. R. Lyall of the D. & W. Fuse Company, and J. Herbert Hall of the Conduits Company of Canada. R. Worth, district sales manager of the company, was chairman of the conference. Papers were read by the different members of the sales department and a great stimulus should result from such an enthusiastic gathering. Others attending were T. J. Waldie, B. C. Holst, H. N. Keifer, W. J. Doherty, H. E. McLeish, J. H. Kimlin, P. E. Overend, W. H. Sellars, H. E. Richardson, V. D. Harrison, A. C. Routh, H. L. Gift and J. P. Carson.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Program of the Seattle Convention, June 11, 12 and 13, 1912.

The following program has been announced for the general, executive, technical, accounting, commercial, power transmission and public sessions of the Seattle convention of the National Electric Light Association, which will be held on June 11, 12 and 13. The convention will begin on the evening of June 10, with a reception and the opening of the exhibition.

Tuesday, 10 a. m.—First General Session.

1—Welcome to the City; 2—Address of President Gilchrist; 3—Announcements; 4—Report of Committee on Organization of the Industry, H. H. Scott; 5—Report of Secretary, T. C. Martin; 6—Report of Insurance Expert, W. H. Blood, Jr.; 7—Report of Committee on Progress, T. C. Martin; 8—Report of Library Committee, Report of Handbook Committee, Arthur Williams; 9—Report on Question Box, E. A. Edkins; 10—Paper: "Expanded Loyalty," Paul Lupke.

Tuesday, 2:30 p. m.—First Commercial Session.

1—Address of Chairman of Section, H. J. Gille; 2—Address: "Commercial Development of the Electrical Industry," W. W. Freeman; 3—Report of Committee on Membership, George Williams; 4—Report of Committee on Steam Heating, S. M. Bushnell; 5—Report of Committee on Electric Refrigeration and Ventilation, John Meyer.

Tuesday, 2:30 p. m.—First Accounting Session.

1—Report of Committee on Uniform Accounting, E. J. Bowers; 2—Paper: "Incandescent Lamp Accounting of the New York Edison Company," W. H. Bogart; 3—Paper: "Handling and Accounting for Scrap Materials," C. E. Bawden; 4—Paper: "General Filing Systems," R. H. Williams.

Tuesday, 2:30 p. m.—First Technical Session.

1—Report of the Meter Committee, O. J. Bushnell; 2—Paper: "Meter Setting," S. D. Sprong; 3—Report of Committee on Grounding Secondaries, W. H. Blood, Jr.; 4—Report of Lamp Committee, F. W. Smith; 4—Report of Committee on Electrical Measurements and Values, Dr. A. E. Kennelly (to be read with Lamp Report); 5—Paper: "Line Voltage," R. E. Campbell.

Tuesday, 8:30 p. m.—First Power Transmission Session.

1—Address of Chairman, Henry L. Doherty; 2—Report: "The Use of Electricity for Irrigation and Agricultural Purposes," C. H. Williams (illustrated by lantern slides and motion pictures).

Tuesday, 8:30 p. m.—Second Commercial Session.

1—Report of Committee on Residence Business, J. F. Becker; 2—Report of Committee on Industrial and Commercial Lighting, E. H. Beil; 3—Report of Committee on Competitive Illuminants, F. H. Golding; 4—Report of Committee on Electric Advertising and Decorative Street Lighting, W. H. Hodge.

Wednesday, 10 a. m.—Second General Session and Executive Session.

1—Report of the Rate Research Committee, E. W. Lloyd; 2—Paper: "The Desirability as a Central-Station Load of Pumping for Municipally Owned Water-Works," C. A. Munroe; 3—Paper: "Educating Central-Station Employees," H. E. Grant. (To be discussed in Company Section meeting Thursday p. m.)

Executive Session (12 or 12:30).

1—Action on Report of Public Policy Committee, Arthur Williams; 2—Presentation of Proposed Constitutional Amendments, Frank W. Frueauff; 3—Report of Treasurer, G. H. Harries; 4—Election of Nominating Committee.

Wednesday, 10 a. m.—Second Technical Session.

1—Report of the Committee on Terminology, W. H. Gardiner, Jr.; 2—Paper: "New Current-Consuming Devices," F. N. Jewett; 3—Paper: "Twenty-Four-Hour Service in Small Central Stations," Taliaferro Milton; 4—Report of Committee on Overhead Line Construction, Farley Osgood.

Wednesday, 10 a. m.—Second Accounting Session.

1—Paper: "Proper Accounting for the Sale of Electric Devices," L. M. Wallace; 2—Paper: "Scientific Management of an Accounting Department," Franklin Heydecke; 3—Paper: "Central-Station Motor Vehicle Costs and Their Distribution to Accounts Benefited," E. C. Scobell.

Wednesday, 2:30 p. m.—Second Power Transmission Session.

1—Paper: "Work and Publications of the United States Government Relating to Hydroelectric Development," J. S. Hoyt; 2—Report of Power Transmission Committee of the Association, J. R. McKee; 3—Report of Committee on Power Transmission Progress, T. C. Martin; 4—Paper: "Switchboard Practice for High-Tension Power Transmission," Stephen Q. Hayes.

Wednesday, 2:30 p. m.—Third Commercial Session.

1—Report on Electric Vehicles, L. R. Wallis; 2—Report: "Electricity in Rural Districts," J. G. Learned; 3—Paper: "A Plan for Increasing Power Load," H. W. Cope; 4—Report: "Selling Current to Larger Power-Users," Joseph Lukes.

Wednesday, 2:30 p. m.—Third Accounting Session.

1—Paper: "Regulated Electric Light Accounting," H. M. Edwards; 2—Paper: "Progress Made in the Uses of the Tabulating Machine," Mr. Schmidt, Jr.

Wednesday, 8:30 p. m.—Public-Policy Session.

1—Musical Program; 2—Reading of Report of Public Policy Committee, Arthur Williams; 3—Report of the Medical Commission of Resuscitation From Shock, W. C. L. Eglin; 4—Lecture: "Electrification of the Panama Canal" (illustrated by lantern slides).

Thursday, 10 a. m.—Fourth Commercial Session.

1—Report of Committee on Cost of Commercial Department Work, E. L. Callahan; 2—Report of Committee on Contract Order Routine, T. I. Jones; 3—Report of Committee on the Commercial Index, E. L. Callahan; 4—Paper: "Ozonators and Their Exploitation by the Central Station," M. O. Troy.

Thursday, 10 a. m.—Third Technical Session.

1—Report of Committee on Prime Movers, I. E. Moultrop; 2—Report of Committee on Electrical Apparatus, L. L. Elden; 3—Report of Committee on Underground Construction, W. L. Abbott; 4—Paper: "Care and Operation of Transformers," W. M. McConahey.

Thursday, 2:30 p. m.—Third Power Transmission Session.

1—Report of Committee on Receiving Apparatus for Use on Transmission Lines, F. B. H. Paine; 2—Paper: "Corona on High-Tension Lines," G. Faccioli; 3—Report of Committee on Protection From Lightning and Other Static Disturbances," S. D. Sprong; 4—Topical Discussions (time permitting).

Thursday, 2:30 p. m.—Third General Session and Executive Session.

1—Paper: "Some Uses of Metals," Dr. W. R. Whitney; 2—Report of the Committee on Electrical Apparatus, W. Lieb; 3—Report of the Committee on Memorials, T. C. Martin; 4—Report of the Committee on Constitutional Amendments, Frank W. Frueauff; 5—Vote on Constitutional Amendments; 6—Report of Nominating Committee; 7—Election of Officers; 8—Adjournment.

Thursday, 3 p. m.—Company Sections Session.

1—Report of Committee on Award of Doherty Gold Medal, W. W. Freeman; 2—Discussion of Grant Paper; 3—The Proposed Company Section Lecture Bureau, T. C. Martin; 4—Experience Meeting as to Company Section Work.

INDUSTRIAL

TRANSFORMERS FOR THE SOUTHERN SIERRAS POWER COMPANY.

The Fort Wayne Electric Works of the General Electric Company is furnishing to the Southern Sierras Power Company a large number of distribution transformers for outdoor service on 33,000-volt, 60-cycle circuits.

The transformers are of the shell-type construction, with separately wound primary and secondary coils. Each coil has a continuous layer of insulation and is spaced and separated from the other coils by means of heavy insulating channels and shields. The primary winding is so arranged that the taps are brought out from the interior or neutral part of the winding in order to minimize danger of trouble at this point. The terminal block is submerged in oil.

Outdoor Distribution Transformer for 33,000 Volts

The wire used in the high-voltage winding is first enameled and then doubly cotton covered. That portion of the winding which connects to the line has four cotton coverings, and the last turns of each coil are furthermore individually wrapped with a double thickness of varnished cambric or empire cloth, so that each turn will withstand several thousand volts break-down test. This extra heavy insulation on the end turns is to enable the transformer to stand up under high-frequency discharges and line surges.

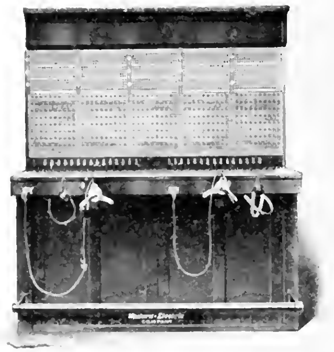
The high-tension insulators, tested at 80,000 volts, are cemented to an auxiliary cover bolted to the main cover; after the core, coils and main cover are in place the final connections between the coils and the high-tension terminals are made through an additional handhole in the main cover, which at the same time provides a convenient means of filling the transformer with oil.

The transformers have successfully withstood breakdown tests of 170,000 volts between primary and secondary and ground.

Especial care is taken in the construction of these transformers to prevent injury to the coils and core due to shifting during shipment. A heavy cast-iron cradle bolted to the base of the tank so supports both core and coils that there is practically no possibility of their shifting.

A NEW MAGNETO MULTIPLE SWITCHBOARD.

It has been announced by the Western Electric Company that, in response to the many requests made for such equipment, their engineers have recently completed the development of a magneto multiple switchboard with a jack for every line within easy reach of each operator. The new switchboard, known as the No. 1013 type, is designed for use on local battery magneto telephone systems where, on account of local conditions, a central battery board would be out of the question.



Western Electric Magneto Multiple Switchboard.

The No. 1013 switchboard is intended for telephone systems having an ultimate capacity of 1500 lines or less and where the traffic conditions make it necessary to take advantage of the inherent rapidity and efficiency of operation obtained with a multiple switchboard. The sections are five panel, two-position and, when lined up in the operating room, present the appearance of one continuous cabinet. A cable turning section with a terminal rack is provided for the head end of the switchboard line-up, matching the other sections in design and finish.

The line and cord circuit apparatus makes use of the familiar No. 4 type combined jack and signal with the red spherical shutter. The multiple jacks are mounted in strips of twenty, each jack being on an individual frame so that any one may be removed at will. Each jack has a hardened German silver sleeve, thus reducing wear to a minimum. The clearing-out signal or supervisory signals are modified combined jacks and signals in which the jacks have been replaced by push buttons for restoring the signals. This provides positive supervision.

TRADE NOTE.

The Pelton Water Wheel Company is building for the Alaska Treadwell Gold Mining Company a 2000-h.p. impulse wheel, to operate at 300 r.p.m., direct-connected to a General Electric generator. The unique characteristic of this wheel is that it is of a double-nozzle single-overhung type. Both nozzles are under the control of a Pelton oil pressure governor for water economy.

NEWS NOTES

INCORPORATIONS.

FARMINGTON, WASH.—The Farmington Rural Telephone & Telegraph Company has filed articles of incorporation.

SAN FRANCISCO, CAL.—Industrial Gas Company; $200,000, shares $10 each, subscribed $50; by E. E. Combs, H. L. Morrison, J. M. and Louis Trachsler and O. L. Berry.

TROUT LAKE, WASH.—A rural telephone company was recently organized here with the following officers: John Weingarten, president; E. E. Wright, treasurer; H. N. Williams, secretary. The company will start work at once.

LAS VEGAS, N. M.—Articles of incorporation have been filed for the Mora Light & Power Company, with capital stock of $5800. The directors are Joseph J. Fuss, Henry J. Shaw and J. Franklin Hornig. An electric light plant will be built.

TRANSMISSION.

WHITE SALMON, WASH.—The Northwestern Electric Company has secured a site near here for the erection of their large dam, to cost about $100,000. The company proposes to light Portland and near-by cities.

LEWISTON, IDAHO—The Lewiston-Clarkston Improvement Company has purchased a right-of-way for transmission lines and a site for a sub-station and will start work at once. The improvement will approximate $20,000.

WALLOWA, ORE.—George Jacobs, of Portland, has purchased the Wallowa Light & Power Company and will install a high-power transmission line connecting Enterprise, Lostine and Wallowa. This place will also have daylight service.

CALDWELL, IDAHO—It is reported that the Idaho Consolidated Power Company will shortly start the construction of the huge power plant at American Falls. The company will spend $50,000 this season, while the total cost will run into the million mark.

SALEM, ORE.—The McKenzie Valley Irrigation & Power Company has filed on water in the McKenzie River and Clear Lake sufficient to develop 44,000 horsepower. It is believed the Hill railroad interests are behind the company, seeking to secure control of this power source against the Harriman interests.

EUREKA, CAL.—General Manager H. L. Jackman of the Western States Gas & Electric Company has announced that the work of establishing a new plant on the western bay shore is to be rushed to completion as rapidly as possible. It is possible that the plant will be ready for service by the latter part of the summer. A steel and reinforced concrete building is to be erected in which to house new equipment, principal among the machines to be a great turbine now on its way to Eureka. A tall reinforced concrete stack is to be built and an intake tunnel from the bay is to be excavated. In all, the new work will call for an outlay of something like $100,000.

KLAMATH FALLS, ORE.—It is announced that, barring accidents, the big power line of the California & Oregon Power Company, which is now building from Dorris, Cal., will be in Klamath Falls within sixty days. Construction has already commenced, and the crew is now working about six miles this side of Dorris. E. B. Henry is the engineer in charge of the survey and is right-of-way agent. From Dorris, Cal., the line runs to Worden, Ore., and then follows the right-of-way of the railroad through Texum. Crossing the river at the Reams ranch, the line comes up the west side of the Klamath River to the power plant in this city. According to Henry, the line is a high-tension line and will carry about 20,000 volts. It is being built to carry as high as 50,000 volts if necessary. When built to Klamath Falls, the company will have lines connecting all its power plants in Southern Oregon and Northern California, including Gold, Ray, Fall Creek and one at Dunsmuir, Cal. The Klamath Falls plant already has lines entering Merrill and Bonanza, Ore., and intermediate points and will gradually extend.

TRANSPORTATION.

SEATTLE, WASH.—The Highland Park & Lake Burien Railroad has been granted a permit for the construction of their tracks in the city limits.

NEW WESTMINSTER, B. C.—The Western Canada Power Company will start the survey soon for the construction of the proposed line from Vancouver to Mission tram line.

IDAHO FALLS, IDAHO—Citizens of this place are planning to build an electric road into a rich country in the Basalt and Poplar districts, connecting with the Oregon Short Line for traffic.

EUGENE, ORE.—The Portland, Eugene & Eastern Railway Company has resumed the construction of its line. It has also purchased a tract 80x160 feet at Eleventh street for freight yards.

RICHMOND, CAL.—Announcement has been made by officials of the East Shore & Suburban Electric Railroad of plans for the expenditure of $50,000 in the building of a substation and carbarns at the terminal of the line in Richmond.

LOS ANGELES, CAL.—Actual construction work on an electric railway to connect Riverside and Imperial will be started not later than next September, according to announcement made by C. B. Conlin, Los Angeles railroad promoter. Others interested are: J. H. Byerly, F. G. Leyman, Congressman J. A. Downey and W. B. Canfell. Preliminary survey for the line will commence at once.

ANAHEIM, CAL.—According to William Gerdes of South Los Angeles street, who is associated with Los Angeles and Eastern capitalists in the construction of a network of interurban railways from this city, the Anaheim City & Interurban Railway Company will incorporate at once for $500,000. Mr Gerdes states that they intend to be operating cars on the line between Anaheim and Fullerton within a year after receiving franchises, which are to be asked for through Fullerton, Orange and Santa Ana.

OAKLAND, CAL.—An order has been issued by the Southern Pacific Company to the effect that its new interurban electric coaches that serve the residents of Oakland, Alameda and Berkeley are to be painted a cherry hue. This color will be the same as the cars of the Pacific Electric Railway of Los Angeles, a subsidiary of the Southern Pacific, and all of the electric cars of the railroad will then be of the same shade, the cars of the Peninsular Railroad also being cherry. The change is to be gradual, as the cars go through the shops for painting.

SAN FRANCISCO, CAL.—The Board of Public Works has received proposals from two car-building companies to construct 43 cars for the Geary-street road. The local concern, W. L. Holman & Company, submitted the lowest offer. Its proposition was to furnish composite or semi-steel cars for $7700 each, while the corresponding bid of the competitor, the Pierson-Roeding Company, was $7780. The four extra trucks which are to accompany the 43 cars Holman & Company offered to supply for $1500 each, while the rival bidder asked $1600 each. For wooden cars Holman & Company

asked $7,000 each. The board took the bids under advisement.

RICHMOND, CAL.—There will be no incorporation of a new town near the county line, and the double-tracking of the electric line from Oakland to Richmond will proceed without further obstruction. These results were achieved through the visit of the Contra Costa County Supervisors and Attorney Mackenzie. Chairman J. H. Trythall of the Supervisors suggested a compromise under which the largest realty owners and the county would agree on a grade and the county would improve San Pablo avenue with oil macadam. The double-tracking of the road into Richmond will be finished in a few days now, and there will be no city of Pullman.

ILLUMINATION.

VALE, ORE.—The voters have authorized an electric light and power franchise for the Idaho-Oregon Light & Power Company.

SAN JOSE, CAL.—The Board of Supervisors on May 20th will adopt a resolution calling for bids for the installation and operation of a lighting system.

ALHAMBRA, CAL.—Fire of uncertain origin has totally destroyed the Alhambra Gas Works, valued at $10,000 and owned by the Low Gas Works of South Pasadena.

STITES, IDAHO—The City Council has granted a franchise to the Kooskia Milling & Power Company to erect and operate an electric light and power plant within the city limits.

OXNARD, CAL.—Sealed bids will be received until May 21st for the purchase of sixty of the municipal street lighting bonds, 1912. Each of said bonds is of the denomination of $500, dated May 1, 1912, bearing 5 per cent interest, payable annually.

EPHRATA, WASH.—Martin Kramer, representing Seattle parties, has asked for a franchise for installing and operating a light and power plant in this city. The proposed plant will have 300 horsepower and will furnish power to farmers in the valley.

NEWPORT, CAL.—The Board of Trustees has turned down the application of the Newport Bay Light & Power Company for a five-year franchise and will order an election in June to submit the question of light and power bonds to the vote of the people.

WILLIAMS, CAL. Fire has destroyed the electric light and power plant of this city. Machinery valued at $30,000 was totally destroyed. Principal stockholders of the company are R. J. Arey of Los Angeles, H. C. Phelan of San Francisco, Jacob Caufi and C. H. Adams. It is probable the plant will be rebuilt at once.

EL PASO, TEX.—The El Paso Gas & Electric Company has entered upon another campaign of improvements calling for an expenditure of $60,000 this summer. Thomas J. Jones, general manager of the company, states that it is necessary to build another storage holder. Machinery will be added, larger offices built and mains extended.

LONG BEACH, CAL.—At a meeting of the Long Beach Consolidated Gas Company a bond issue of $250,000 was voted to extend its facilities. A new plant will be erected on West Anaheim street and modern first-class machinery will be installed. San Pedro, Wilmington and Dominguez will be supplied with gas. Work will begin as soon as contracts can be let.

SAN FRANCISCO, CAL.—Bids will be received at the Chronicle building until May 31st, for the construction of an electric lighting system at Fort Columbia, Wash.; also, for furnishing and installing engine, generator and switchboard in the present power plant at Fort Stevens, Ore., and for the construction of feeder lines and pump house with pumps and motor at Fort Stevens.

STOCKTON, CAL.—Plans that will necessitate the expenditure of at least $200,000 for the installation of an underground system of service wires are now being perfected by the Great Western Power Company, and as soon as material now en route arrives and the proper arrangements can be made, work will be started. H. W. Reilly, superintendent of construction for the H. M. Byllesby interests, is in Stockton to advise Manager W. W. S. Butler and to direct the work during the actual installation of the conduit system, to embrase the entire business district.

TELEPHONE AND TELEGRAPH.

ALTURAS, CAL.—Leland & Myres have been granted permission to operate telephone lines along and across thoroughfares of Modoc County.

OAKLAND, CAL.—The final steps in the complete absorption of the Home Telephone Company by the Pacific Telephone & Telegraph Company were taken when officials of the latter concern filed deeds of the transfer with County Recorder Bacon. The transfer includes the submarine cable between this city and San Francisco, as also all the property of the Home company within and without the counties of Alameda and San Francisco.

PASADENA, CAL.—That Pasadena will have a single telephone system within less time than the six months given the Sunset Telephone Company to accomplish that end seems certain from telephone development of the past few days. The majority of the Pasadena Home Telephone Company stock has been disposed of, presumably to the Sunset company. At the headquarters of the Home company it is intimated that a statement regarding the matter will be given out this week. The Sunset company has never denied being in the market for the Home company here; the only question was one of price. It is understood that the $40 a share at which local people have sold represents the actual sum per share expended. The shareholders do not make anything; they simply get back what they have put into the system.

WATERWORKS.

FULLERTON, CAL.—The question of a municipal water system is being considered. Engineers have prepared plans at estimated cost of $65,000.

MONMOUTH, ORE.—The City Council has rejected all bids for the construction of a new water system because they were considered unreasonably high.

MODESTO, CAL.—Sealed bids will be received up to May 29, 1912, for furnishing the material and doing the work for the reconstruction, enlargement and extension of the city water system.

PORTLAND, ORE.—The city of Clatskanie, Ore., will, on the 10th of June, offer for sale by sealed bids bonds in the amount of $20,000, the proceeds to be used in the construction of a water system in said city.

SANTA CRUZ, CAL.—A petition has been presented to the City Council asking for a franchise to establish and operate a new system of waterworks for supplying the inhabitants of Santa Cruz with pure water for domestic purposes.

NEWARK, CAL.—The Newark Water Company, owned by the firm of Edward Salz, Inc., Decoto, has been sold to the Union Water Company of Oakland. The transfer went into effect on the first day of the month and representatives of the new ownership are on the ground and already in charge of the plant. No promises of improvement of service have been made, but rumors are that the new owners will soon install larger mains.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

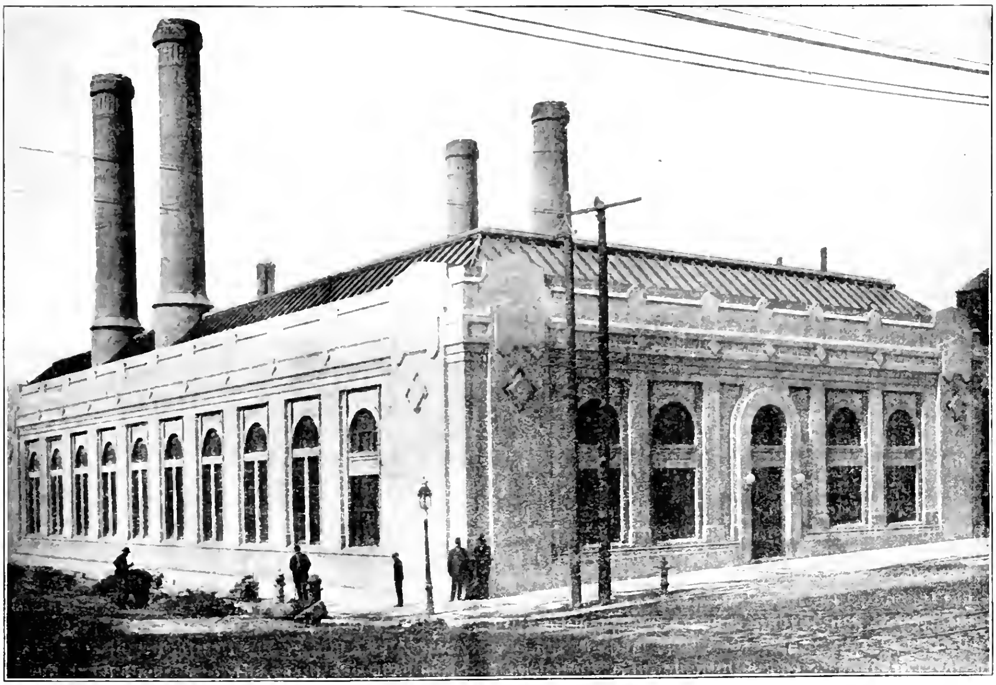
VOLUME XXVIII SAN FRANCISCO, MAY 25, 1912 NUMBER 21

SAN FRANCISCO'S HIGH PRESSURE WATER SYSTEM

BY ROBERT SIBLEY.

On Saturday, May 4th, a notable gathering of Western engineers witnessed the acceptance test of pumping station No. 1 of the high pressure salt water system of San Francisco. The catastrophe of 1906 in which the business section of the Western metropolis was swept from the face of the earth, largely due to the fact that water could not be obtained to fight the fires, led serious-minded men to consider ways and means of insurance against the possible recurrence of this event.

A reservoir has been constructed upon Twin Peaks which delivers fresh water at a 700 ft. pressure to any portion of the city. In case this reservoir should be emptied, an auxiliary high pressure system has been installed to meet the emergency by pumping salt water from San Francisco Bay into the city mains. These mains constitute a network of cross-connections throughout the business district of the city and it is believed to be next to impossible that all the various channels could ever be shattered at one time.


Exterior View of San Francisco's New High Pressure Salt Water Pumping Plant.

Pumping station No. 1, which has just been completed at a cost of $500,000, is located on a lot fronting on Townsend street, and extending from Second

to Stanford street. The station is housed in a Class A building, 160 x 85 ft., facing on Second, Townsend and Stanford streets and in the rear is a lane 15 ft. wide.

The entire excavation for the building is in solid rock. A channel has been cut to the waters of the Bay so that the salt water supply is immediately below the pumps in the power house. Great care was taken in excavating the lower levels in order not to disturb the bed of the soil or rock in the upper levels and in cases where the material was removed at a lower depth than that given in the specifications, the filling and levelling up was done with concrete.

After the completion of the building, the back filling was accomplished with sand and fine gravel in layers not more than 2 ft. in depth, each layer being thoroughly watered down with a hose and rammed solid. Sub-drains of six-inch iron pipe not less than 3/4 in. thick were laid with loose joints and covered in such a manner as to exclude loose earth or sediment but to allow free passage of water.

The steel frame of the building is one of the heaviest which has been constructed in San Francisco and contains 500 tons of steel. It has been designed to withstand the most severe stress. The walls and roof of the building are of reinforced concrete. No expense has been spared to make this building absolutely fireproof. All of the windows are wired glass in metal frames and, in addition, rolling steel shutters are fitted at all openings.

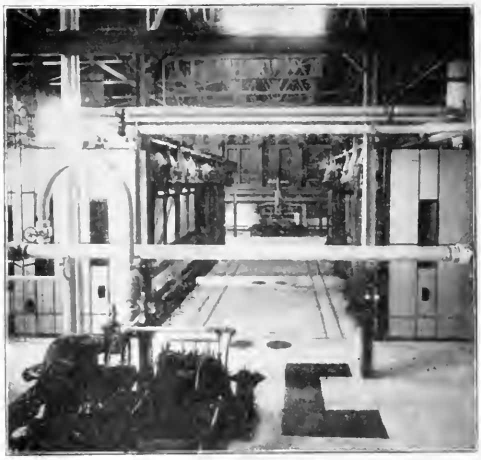
The station throughout has been designed with a view to the greatest simplicity and reliability of operation. All pipes and pumps are in duplicate so that an accident to no part of the plant can result in putting it out of service. Under the floor of the boiler room are six water tanks having a capacity of one million gallons, to store fresh water for the boilers and in Stanford street are five oil tanks having a capacity of 2000 bbls. of fuel oil, so that sufficient oil and fresh water may be stored in the station to permit of its being operated at full capacity for three days continuously without receiving additional supplies of water or oil.

The pumps are arranged to store salt water from the bay through a reinforced concrete tunnel 5 ft. in diameter and 1100 ft. long, extending down Townsend street and through the sea walls. Two pipes twenty inches in diameter are connected to the pumps, one of these leads up Second street to Market street and thence to Sansome and to the pumping station No. 2 at Fort Mason, the other leads up Townsend, Stanford, Brannan, Seventh, Harrison, Ninth, Folsom and Eleventh street and thence to Twin Peaks reservoir and thence to pumping station No. 2. Either of these pipes is sufficiently large to carry the entire discharge of the station and distribute it where it may be needed, so that in the event of one pipe being broken, the other may be used.

Boilers.

Babcock & Wilcox boilers are installed in the pumping station. Boilers are arranged in four batteries of two each, each battery being enclosed by steel plate casings with magnesia covering between the casing and the brick work on the sides and back. The boilers themselves are of the standard type with two drums, 18 ft. 4½ in. long and 42 in. in diameter; 191 four-inch tubes 16 ft. long, arranged 16 ft. wide and 12 ft. high with vertical forged headers. The boilers contain approximately 3500 sq. ft. of heating surface and are rated at 350 h.p each. The burners are of the Hammell type, two in each boiler. Each set of batteries which constitute two boilers are served with independent reinforced concrete smoke stacks as shown in the illustration.

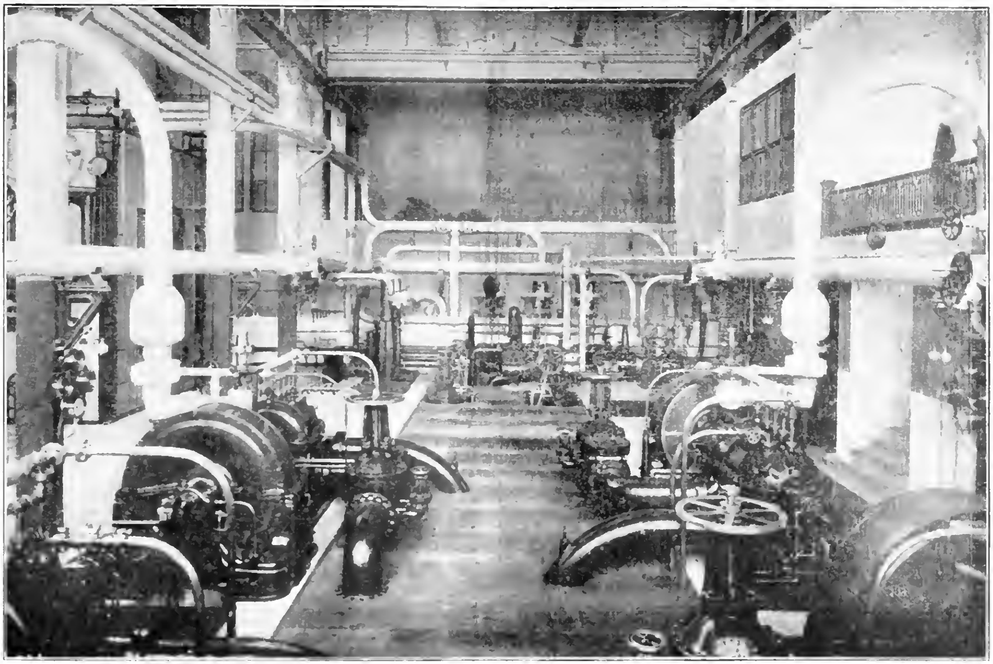
This station, which is maintained and kept in readiness for emergency conditions, is of interest in consideration of the guarantees demanded from the builders. The boilers were guaranteed to be operated



Boiler Installation, Where One Boiler Is Kept Eternally In Readiness for Instant Service.

at their full rated capacity—evaporating the equivalent of 7075 lbs. of water per hour from and at 212 degrees F. at an efficiency of 79 per cent after deducting from the total steam generated by the boiler, the steam required by oil furnaces in atomization of the oil. The boilers were also guaranteed to be capable of being forced to an evaporization of 21,000 lbs. of water from and at 212 degrees F. continuously without injury to the boiler or any part thereof. In regard to the rapidity to be attained in raising steam it was also guaranteed that any boiler should be capable of raising steam to full pressure of 200 lbs. per sq. in. in thirty minutes when the boiler was filled with water to the heighth of two inches in the water glass, with feed water at a temperature of 70 degrees F., it being understood that the steam for atomizing the oil in the furnaces be furnished from another boiler. The feat was of course to be performed without injury to the boiler or any part of it.

The stand-by loss is of interest. In maintaining an emergency station of this type to be ready at all times, full boiler pressure of 200 lbs. per sq. in. must be kept up in one of the boilers at all times. It was agreed that the oil necessary to perform this function continuously should not exceed 5 per cent of the fuel oil necessary to operate the boiler at its rated capacity. In performing its steam generating function each boiler was also guaranteed, whether operated at rated horsepower or at 75 per cent overload, to generate the steam with a moisture condition not to exceed



High Pressure Turbine Units.

of 1 per cent. A full and exhaustive test, the results of which will appear in an early meeting of one of the national engineering societies, performed by Professor Jos. N. Le Conte of the University of California demonstrated that the installation of the boilers had met every condition of guarantee.

Steam Turbines and Pumps.

Four pumping sets or units are installed in this station each consisting of a four stage horizontal turbine pump on the same bed plate and directly connected to a horizontal steam turbine. The pumps have been furnished by Byron Jackson Iron Works of San Francisco. Each pump has a capacity of 2700 gallons per minute and a pressure of 300 pounds per sq. in. when operated at a speed of 1800 r.p.m. The steam turbines are of the Curtis type, manufactured by the General Electric Company. These turbines operate non-condensing under a pressure of 150 lbs. per sq. in. and have a rated capacity of 750 h.p.

In addition to performing the output rating above mentioned, the builders guaranteed that the duty of each pump would not be less than 38,000,000 foot pounds of work performed per one million B.t.u. supplied to the steam turbine, the temperature of feed water being assumed to be 200 degrees F.

After a careful test of the pumps, which test was conducted at the power house of the Oakland Gas, Light & Heat Company, First and Grove streets, Oakland, it was found that all four pumps gave more than the necessary 2700 gallons per minute of salt water discharge and more than the necessary 300 pounds pressure per sq. in. at the discharge nozzle, when working under more than 15 ft. suction lift. The duty of all the pumping units slightly exceeded the required 38,000,000 ft. pounds of work per one million units consumed by the steam turbine. It was also found that the pumps are capable of carrying much higher suction heads than can be carried by the fire boat units installed in San Francisco, the discharge of 1600 gallons per minute under 300 lb. pressure being maintained with a 22-inch vacuum at the suction. The mechanical operation of the units was found perfect throughout the test, there being no heating nor excessive vibration. In fact they operated throughout the entire test with little attention.

The steam driven dynamo for furnishing electric light to the building and the necessary feed water heaters, fuel oil pumps and other accessories complete the installation.

The interior appearance of the power house is of neat and substantial design. In fact it is doubtful if any power installation on the Coast presents the trim and finish observed here, even to the tile flooring. Minute care in design and constructive detail is shown on every hand.

The acceptance test was witnessed by the engineers of the Fire-underwriters, Chamber of Commerce, and the Mission Promotion Society and pronounced a success by them. The station is now in full service and the fires are being kept under one boiler continuously, so that the station is, at all times, ready to furnish fire protection to property in San Francisco and stands as a sentinel, ready at all times to perform its gigantic protective function.

ELEMENTS OF HYDRAULIC ENGINEERING

THE DEVELOPMENT OF THE TANGENTIAL WHEEL.

BY GEORGE J. HENRY.

In the early days of this western country when man sought fame and gold in the mines of California, it took six months to get to the promised land from "Home" and when one landed down at the old wharf on Montgomery and Clay streets with but little else than a pioneer spirit of determination to conquer fortune from the soil, a strong right arm and a sturdy physique were counted the best assets. He could not bring machinery with him for an undiscovered mine, even if such had been attainable in the eastern markets at that period. He could not get it in the west, for everyone was in some more profitable occupation, and at that time, things were too unstable to maintain anything akin to machine works.

Everything that the miner needed had to be packed long distances at enormous expense—an egg sold for one dollar at the old Oregon house on the road from Marysville to Nevada, and although eggs have come down, the old Oregon House has not. Those were the days when the life streams of these western shores ran with the rugged romance of Bret Harte, when the pathos of man's strife with nature was lost sight of in the glowing warmth of his golden heart, when the snows of the Sierras crowned many a grave of hopes and when man forged hard and long for a paltry bit of gold.

During this period of tense action, the discovery and proving of many mining prospects created a demand for power. At probably no period had labor commanded a higher price—laborers in San Francisco, could not be found at less than $15 to $20 a day, and mechanics in every trade were asking fabulous prices. Every man was working for himself, and thus the panning out of gold where found in paying quantities became very arduous and expensive and its cheaper extraction became a necessity. Water was plentiful in the Sierras, especially on their western slopes where many ditch companies developed systems of water supply to the various mines on the Mother Lode. later this water proved a valuable asset and today it is frequently found to be the nucleus for a considerable irrigation system feeding the arable lands in the Sacramento and San Joaquin Valleys which parallel the great range of the Sierras, provided with nature's reservoirs of snow.

This water supply was essential to the working of the mines, and as the ditch was often at a high elevation, the water used for the mine was dropped down to the mill. Considerable energy was thus going to waste unless put to some use by the ingenious miner. What could be more natural than that this necessity for water to wash the gold and work the property, combined with the available water power at the door as opposed to the distant source of supply of water power machinery, should have put to a severe test the inventive genius of the miner. The hurdy-gurdy was the result. This was the forerunner of the modern tangential wheel, and for many years or until the value of water in some of the ditch systems became so great as to practically force the invention of improved and more efficient water wheels it was extensively used. The hurdy-gurdy wheel is now obsolete and has but an historic interest. For years, however, it supplied the needs of the miners of the Sierras in a way, no other then known piece of apparatus possibly could. It was usually made on the ground, of wood and supplied through the most primative of pipe lines and giants, as nozzles were usually called, on account of the name of the most popular nozzle for placer mining then in use.

The vanes (corresponding to buckets on a modern tangential wheel) were at first only flat paddles, and the water from the "Giant" impinged directly on the flat surface, spattering in all directions and transforming but 30 or 35 per cent of the energy in the water into useful energy on the wheel shaft. At a little later date, in the sixties, this wheel was equipped with vanes having a central splitter to divide the stream without shock on entering the vane. This was certainly a great improvement over the older form, but nearly all were still made of wood, and seldom was any careful attention given the question of wheel diameter or speed, and its essential relationship to the head or spouting velocity. The increasing demands for larger amounts of power as the mines developed, and its cost as the price of water supplied by the ditch company advanced, brought again in the early seventies a still further improvement of the greatest importance by Lester A. Pelton. Mr. Pelton was a mill wright well known in the mining section of Nevada County who built many water wheels in the old foundries established in the early days in the mining towns. His early labors showed by practical experiment the now well known advantage to be derived from the tangential water wheel bucket having a central splitter or wedge on which the water entered without shock and passed over the curved surfaces with least resistance gradually giving up its velocity until discharged at as nearly zero velocity from the sides of the bucket cavities as could be practically attained. The patents taken out by Mr. Pelton in 1882 and 1888, as shown in Figs. 20 and 21, are clearly descriptive of the fundamental principles of the wheel so well known the world over today and, although long since expired, they embody the essential elements of every successful tangential wheel.

The early wheels were constructed of wood with cast iron cups bolted or lag screwed on the rim with a circular jet of water from a nozzle impinging on the splitter of the buckets. It seems likely that about the same time, as is frequently the case where the necessity of an invention is so universal, that several others working independently but along the same lines reached the some general design of water wheel bucket, but it is certain that no one else built as many wheels or devoted the time and attention to the attainment of

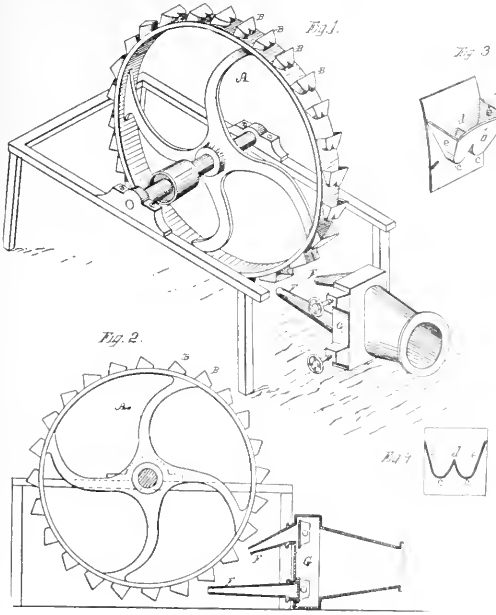


Fig. 20. First Pelton Patent.

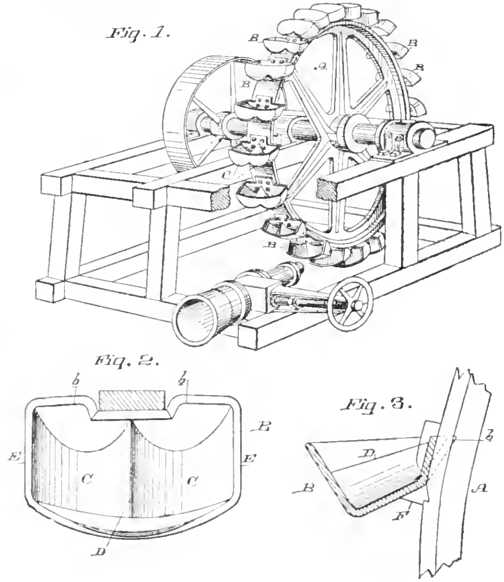


Fig. 21. An Early Pelton Patent.

best efficiency. Shortly after the wheel had begun to attain local fame, the Knight wheel was further improved. Mr. Knight, of Sutter Creek, Cal., made great claims for his wheel shown in Fig. 22, and undoubtedly obtained excellent results. In a comparative test of the two types at the Empire Mine in Grass Valley, however, the Knight wheel did not show up as well as its competitor, and this test thereby established on a firm basis the reputation of the Pelton. Mr. L. A. Pelton in 1888 sold out to A. P. Brayton of the Pacific Iron Works and immediately thereafter the Pelton Water Wheel Company was formed to manufacture this wheel in order to meet a constantly growing demand. Its extreme simplicity, its reliability for continuous service, its ability to utilize high heads with excellent efficiency made it a most attractive prime mover. It was most readily adapted to use on a horizontal shaft, occupied very little space, and at the speeds of the then most popular mining machinery it could be most readily directly connected.

For conducting the water to the wheels, wood pipe was sometimes used although most frequently riveted sheet iron. The high pressures made use of with perfect success in this pipe, which was made up of thin plates, almost seem to defy our well known laws of mechanics. The practice today, however, is to use safety factors much higher than were then generally considered satisfactory.

Automatic speed regulation was not attempted and in fact was scarcely necessary since the cam shaft and concentrators, while requiring a constant speed, offered a constant load. Hence, if a special wheel was devoted to each machine, the most perfect speed control was effected by the occasional manipulation of the main gate valve.

On the other machinery around the mine speed variation did not affect the results. The average mine probably employed 4 to 8 wheels, although at times

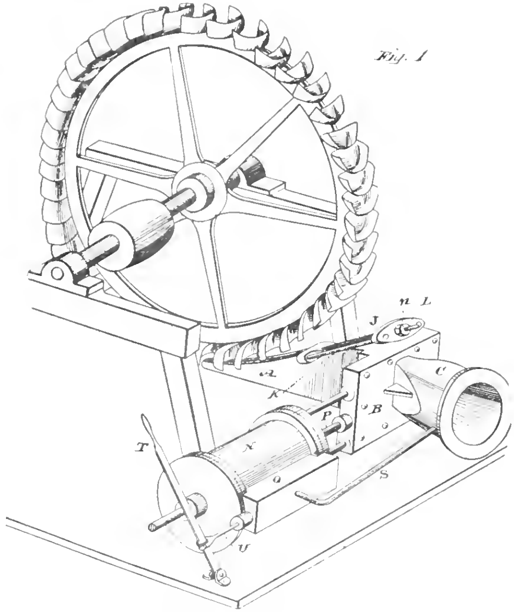


Fig. 22. The Knight Tangential Wheel.

numbering over 20. Without doubt these wheels were the most effective and satisfactory power known for mining. In the early days they were made in sizes up to about 7 ft. and later during the nineties up as

high as 32 ft. to get slow speed under high heads for driving compressors. But in more recent years the tendency is toward units of large capacity and high speed so that diameters have been reduced while buckets, shafts, nozzles, gates and bearings have all been greatly increased.

It is a fact worthy of notice that the wheels built twenty-five years ago gave in many cases extremely high efficiencies. Improvements since then have been along other lines more than bucket design. The patent office records are strewn with inventive efforts on buckets but aside from a very few examples the designs of buckets patented have been the product of the misconceptions of the inventors and but seldom based on a real knowledge of what takes place in the buckets of a tangential wheel and scarcely ever backed by any real experimental investigation.

Some really valuable work has been done however in the machine design of the associated apparatus, especially in nozzles and governors. The great strains involved in the operating parts of a large unit call for the most careful consideration to secure reliable continuous operation.

The buckets must, of course, have the right curvature to receive the water without shock and at the spouting velocity from the nozzle; to take the greatest possible velocity out of the moving water jet during its passage through the bucket with a minimum loss in friction on the bucket surface. This result is attained with an efficiency of from 80 to 92 per cent in well designed wheels. Other losses, however, occur which tend to reduce the wheel output and therefore the efficiency of the apparatus as a whole. These are the mechanical friction, the windage of the rotating wheel, the loss due to the discharge velocity of the water when it leaves the buckets of the wheel, the losses in the nozzle, connecting pipes and gate valve, the loss in the stream after it leaves the nozzle and before being received on the buckets of the wheel is further reduced. These latter losses are greater in any form of regulating nozzle than in a properly designed simple nozzle for the same size stream, but the facility with which the regulating nozzle may be adjusted during operation makes its all day efficiency much superior if water economy at partial loads is of value. If however, the adjustment of a regulating nozzle, whether by hand or automatic device, does not result in holding in suitable storage the water that would otherwise be wasted, so that it can be used later during say peak load or if variations in the stream flow which make it necessary to correspondingly curtail the output in the power house do not occur, then it is much better to use a simple non-adjustable nozzle with a counterbalanced stream deflector and to allow a constant flow through the nozzle whether it is all used for power or not.

It is a noteworthy fact that the Pacific Coast and particularly California has led the world in tangential water wheel development. European practice in these wheels is now following along with a lag factor of several years. The high efficiencies recently reported by European makers are being obtained with bucket shapes that have been in use in this country for a considerable time and long ago their superiority has been demonstrated.

As to the proportions of buckets of tangential water wheels and the theory of their action, it may be stated at this time that this type of water wheel is particularly adapted to higher heads and smaller water quantities than the turbine class of wheels.

Tangential wheels employ a stream or streams issuing at spouting velocity, the entire energy of the falling water being kinetic, whereas turbines, as generally used, transform the energy of the falling water partly from the pressure and partly from the velocity or, more properly the velocity pressure.

To make clear the effect of the falling water on the buckets or vanes of a water wheel let us look at the formulae for falling bodies. The velocity or rate in feet per second which a body will be travelling after it has fallen under the action of gravity (as is the case in most problems of hydraulics) through a distance h feet will be the square root of twice the acceleration of gravity multiplied by the height, or expressed mathematically

$$v = \sqrt{2\,g\,h}$$

The acceleration of gravity is equal to 32.16 and therefore the above formula may be written

$$v = \sqrt{2\,g\,h} = \sqrt{2 \times 32.16\,h} = \sqrt{64.32\,h} = 8.025\sqrt{h} \ldots (1)$$

This gives us at once the spouting velocity for any head. It must be borne in mind that h is the head acting at the point of issue and therefore if the water is delivered from a pipe line the head h is what is left after deducting the friction loss.

Example 1. What will be the spouting velocity under a surveyed head of 520 ft. when the friction loss is 30 ft? In this case we have 520 — 30 — 490 ft. effective head and therefore

$$v = 8.025\sqrt{490} = 8.025 \times 22.11 = 177.67 \text{ ft. per second.}$$

It needs no demonstration to see that if the area of the stream be represented by a then the quantity that will issue from the nozzle will be

$$Q = a\,v = 8.025\,a\sqrt{h} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Example 2. What quantity in cubic feet per second will flow in a two-inch diameter circular stream issuing under an effective head of 490 ft?

d = diameter of stream in inches, then 2 inches circular stream has an area of

$$\frac{\dfrac{\pi d^2}{4}}{144} = a = \frac{3.1416}{144} = .0218 \text{ sq. ft.}$$

$$Q = a\,v = .0218 \times 177.67 = 3.87 \text{ cubic feet per second.}$$

The energy of a falling body may be represented by the weight of the body multiplied by the height it falls and as the weight of a cubic foot of water = 62.4 pounds we have the footpounds of energy represented by

$$62.4 \times Q \times h = 62.4\,Q\,\frac{v^2}{2g} = \text{ft. pounds} \ldots\ldots\ldots\ldots (3)$$

and as there are 550 ft. pounds per second expended in producing work at the rate of one horsepower have theoretically

$$H.P._T = \frac{62.4\,Q \times h}{550} = \frac{62.4}{550} \times \frac{v^2}{64.32} \times Q \times h \ldots\ldots\ldots (4)$$

and if the water wheel has an efficiency of μ then the horsepower from the wheel would be represented by

$$\text{H.P.} = \mu \frac{62.4}{550} Q \times h = .1134\, Q\, h\, \mu = .001763\, v^2 Q\, h\, \mu \ldots (5)$$

Example 3. What horsepower should we expect from a wheel running at 80 per cent efficiency under 490 ft. effective head and using a 2 in. jet of water?

$$\text{H.P.} = .1134 \times 3.87 \times 490 \times \frac{80}{100} = 172$$

The pressure exerted by a column of water at rest may be determined by considering that 1 cubic ft. of water weighs 62.4 pounds. The weight of pressure on each square inch of the base will therefore be

$$\frac{62.1}{144} = .433 \text{ pounds.}$$

and for a height of column h ft. we would have

$$p = .43\, h \text{ or } h = \frac{p}{.43} = 2.33\, p \ldots\ldots\ldots\ldots (6)$$

Example 4. What will the pressure gauge indicate when the gate in example 1 is closed?

520 × .433 = 225.16 pounds per sq. in. and when the gate is open and the effective head is 490 ft. then

490 × .433 = 212.17 pounds per sq. in.

To arrive at a clear understanding of velocity pressure, think of what happens when we hold a stick in a flowing stream. The water will crowd upon the upstream side, and the greater the velocity of the current the higher it will rise against the stick. The height to which it will rise is a measure of the velocity and therefore the head producing the velocity. If we eliminate losses, as would be approximately the case if we turned a jet of water upwards in a vacuum from the bottom of the pipe, we would then have all the kinetic energy of the falling water raising the same water quantity and therefore it would rise to the same height as that from which it fell namely, h.

If we were to register the force of the impulse we would find that the pressure against a frictionless surface was twice the static pressure as shown in Fig. 23.

$$\text{Impulse} = \text{mass} \times \text{velocity or } F = m\, v \ldots\ldots\ldots\ldots (7)$$

which is one of the fundamental equations in mechanics.

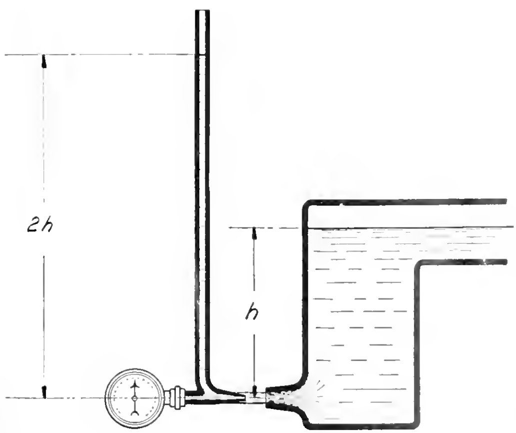


Fig. 23.

In the case of a jet of water the mass $= \dfrac{\text{weight}}{\text{gravity}}$

and therefore $\dfrac{62.4 \times a \times v}{g}$ = weight of water striking the unit surface in one second and therefore for an area of one sq. in. we have

$$\frac{62.4}{144} \times \frac{a\, v}{g}$$

and

$$F = \frac{62.4 \times a\, v}{144} \cdot \frac{v}{g} = \frac{2 \times 62.4}{144} \times \frac{a\, v^2}{2g} = \frac{124.8}{144} a\, h = .866\, h \ldots (8)$$

from which we see by comparing with equation (6) that the pressure due to the impulse is twice the hydrostatic pressure.

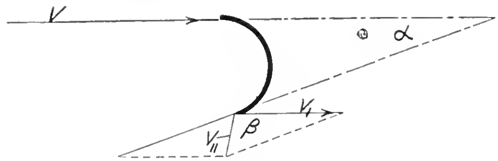


Fig. 24.

If instead of a plain surface we use a curved surface to receive the jet of water as shown in Fig. 24, then the force of impulse will tend to force the surface in the same direction and as the water curves over the return portion (that is $< 90°$) there is a reactive force lost by the returning water equal to

$$\frac{w\, v_1 \cos \beta}{g} \text{ because } \quad > o° \ldots\ldots\ldots\ldots (9)$$

i.e. the return is not complete and therefore the reaction is equal to the impulse

$$\frac{w\, v_1 \cos \beta}{g}$$

Where W is the weight of water discharged by the bucket in one second. Combining the impulse and reactive component we then get

$$\frac{w}{g}(v - v_1) \ldots\ldots\ldots\ldots (10)$$

$$\text{as the impulse} + \left(\frac{g}{w}(v - v_1) - \frac{g}{w}(v_1 \cos \beta) \right)$$

$$F = \frac{w}{g}\left((v - v_1) + (v - v_1) - (v_{11} \cos \beta) \right)$$

If now $\alpha = o$, then $v_1 = o$ and if $v_1 = \dfrac{v}{2}$

the condition approached in tangential wheels, then we have

$$\frac{w}{g}(v - v_1) + (v - v_1) - (v_{11} \cos \beta) = \frac{w\, v}{g} = \text{total impulse}$$

and by (8) this = .866 h.

which is twice the static pressure when the wheel pitch circle is running at 50 per cent of the water jet velocity.

By the same reasoning it will be seen that if the wheel be locked and full jet turned on the buckets the impulse + reaction, that is the total effort tending to move the bucket and therefore straining the bolts and balance of the structure will theoretically be

$$\frac{w}{g}(v + v_1) = \frac{2\,w\,v}{g} = 1.732\,h \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

which is twice the normal running impulse and four times the static pressure. On the other hand it is also seen that the impulse entirely disappears when $v_1 = v$ and the wheel would then be running at spouting velocity.

Due to the action of the jet alone the wheel can never attain spouting velocity but can only run at such a speed that there will be a sufficient impulse + reaction to overcome the actual load + the losses of friction and windage.

In practice the velocity of the pitch circle of the wheel is designed to run not at 50 per cent of the spouting velocity as determined from the gross head reduced by friction in pipe (H — f — h) but at about 47 to 49 per cent of the actual spouting velocity reduced by gate and nozzle and windage and bucket surface friction losses. In other words all the hydraulic losses that occur tend to reduce the velocity causing the impulse and reaction. This corresponds in most cases with 42 to 47 per cent of $v = \sqrt{2gh}$.

ERRATA NOTICE.

The Rotary Air Compressor.

In the discussion of the rotary air compressor, which appeared in these columns of March 23d, several errors were introduced and hence the following errata should be noted by those following this series of articles.

In the equation for power the mean effective pressure p, should be used. Thus,

$$p = \frac{p_1}{k v_1}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

Hence

$$\text{Power} = \frac{p\,Q_1}{550}$$

in which Q_1 is the cu. ft. per sec. entering the impeller blades, and p the mean effective pressure.

Thus in the illustrative problem of the same issue we should compute the power as follows:

$p_1 = 14.7 \times 144 = 2{,}120$ lb. per sq. ft. $v_1 = 13$ cu. ft. per lb.
$p_2 = 69{,}650$ lb. per sq. ft.
Since $p_1 v_1^{1.41}$, we have: $2{,}120 \times (13.1)^{1.41} = 69{,}650 \times v_2^{1.41}$
$v_2 = 1.103$ cu. ft. per lb.

$$\therefore Q_1 = Q \times \frac{13.1}{1.103} = \frac{1{,}000 \times 13.1}{1.103} = 11{,}875 \text{ cu. ft. at } 14.7$$

lb. per sq. in.

$$p = \frac{p_1}{k\,v_1}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right] \text{ mean effective pressure.}$$

$$\text{Substituting: } p = \frac{2{,}120 \times 1.41}{.41 \times 13.1}\left[\left(\frac{69{,}650}{2{,}120}\right)^{.291} - 1\right] = 982 \text{ lb. per sq. ft.}$$

$$\therefore Po = \frac{982 \times 11{,}875}{550 \times 60} = 353.0 \text{ Horsepower.}$$

Which is the total h.p. delivered to the shaft of the impeller.

In addition in the derivation of the several formulas in the article above referred to, the following errors occur, viz:

$$\frac{p_2}{p_1} = \left(1 + k\frac{W}{p_1 V_1}\right) \ldots\ldots\ldots\ldots \text{should be } \frac{I}{k} \text{ exponent}$$

$$W = e\,N = \frac{u_a^2}{1\,g} \text{ should be } W = \frac{e\,N\,u_a^2}{g}$$

PROFIT-MAKING IN ELECTRICAL CONTRACTING.[1]

BY LOUIS LEVY.

In figuring contract work—that is in estimating from a plan and specification as submitted by architects, we use a form printed for the particular purpose. On one side of the sheet is room for itemizing each floor of the job and, if it is an irregular job, there is space for itemizing each room with places for the number of outlets—whether center or bracket, also whether single, 2, 4, lights, etc. On the same line as the outlet we have space for the plugs, switches, circuit, the number of feet of conduit necessary to complete that particular outlet, and also the wire and a place for the labor necessary to install the particular material we have listed as necessary for the outlets marked. When we get through taking off a job, we have measured up every piece of pipe in the most particular way, and taken off our labor in so close a manner that we feel we are not guessing but actually figuring labor. We then add the quantities we have listed and this gives us the number of feet of conduit, wire, hours of labor, and all other information.

On the reverse side of the sheet we have columns for quantities—a printed list of material and column for price on each and in total—also a separate column for the finish of the job. We get our total quantities from the details listed and in figuring our cost we use prevailing prices at which we can buy material.

We have used in past years—when we were doing bush and knob work—a method of averages at so much per outlet, but on conduit work, we have not done enough to warrant us to try this method, unless we are not particular as to whether we get the job.

After the amount of cost is computed, the percentage we expect to get as profit is added and a bid is made out on printed forms for that purpose. At the present time we are adding 50 per cent of our cost to arrive at the amount we should bid on the job. The copy of the bid and the estimate itself are then filed in numbered envelopes. We use a 4 x 6 filing cabinet to index these envelopes—use the locations as the main index and cross-index under architects, owners and contractors headings. Our files now are as high as 4300, each number representing something in the way of overhead expense without any guarantee of return for the investment.

We do not attempt, with very few exceptions, to follow up an estimate—believing that if we are low we will generally get the job.

When we do get a contract, we open a folder in a filing cabinet, which is legal size, and head it by whatever letter of the alphabet it may be, and the next number; as, for instance, the Coliseum would be C and if 97 was the last number under C that was used, the new contract would be C-98. All papers are transferred to this folder—a copy of the inspection report, also all papers which refer to the contract, as well as plans, and we make a practice of getting a set of plans and specifications of every job we do, so that we can lay our hand on any plan asked of us for possibly five years back.

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[1]A paper read before San Francisco Local No. 1, California State Association of Electrical Contractors.

At the time of opening the contract we enter the number in a small book, in which is kept the inspection number, a record of labor and material tag numbers. These tag numbers are entered in this book before an order for material is filled and we have by this means an index to all material charges which should be in the file when the contract is completed.

1st. Amount of contract work on hand;

2d. Amount of labor and material installed on unfinished contracts;

3d. Amount of money billed on unfinished contracts;

4th. Amount of gross profit on finished contracts;

5th. Amount of actual profit on contracts.

The entries are necessary for any one to keep his cost up to the minute and not as most of us have done—leave it accumulate and unless in special instances—never total up.

When we secure a contract, we make a journal entry charging an account called "Work to be performed" and crediting a "Contract Account."

When materials go out, the cost is charged in total at the end of the month to an account called "Cost of Contracts" and credited to "Material Account." Of course, this means figuring cost of each material item, but if this is done, your material account tells you how much stock you have on hand continually, providing you charge material account with your purchases. I believe now that most of you depend on your yearly inventory to tell you what your stock is. We post cost of each material item to loose sheets headed Cost of Contract Sheets, having a separate sheet for each contract and the total of these sheets must correspond with "Cost of Contract" in the ledger. We do the same with labor—we have a "Labor Account" same as "Material" and this account tells how much is paid, while the "Cost of Contract" account is charged with what is paid. Each item is posted to the contract on which it applies. The total of the labor charged on these cost sheets must correspond with the total of what shows in the labor column of the "Cost of Contract." This is the part which must be kept up and you will see later when at the end of the month—the finished contracts are taken out from the unfinished contracts.

When the job is roughed in—we send a bill calling for 75 per cent of the contract—as a rule. We use one copy of the bill as a journal entry and the other is filed in the folder mentioned before when we first opened the contract. The journal entry is posted as follows: the Accounts Receivable account is charged and the "Work to be Performed" account is credited. As this "Work to be Performed" account now stands, it shows the amount not billed on contracts which are on the books.

At the end of the month, all finished contracts are handled together and the cost of each contract is charged to "Finished Contracts" and credited to "Cost of Contracts." We get the cost of each contract from our cost sheets which you will remember were to be posted each day. The result of this entry is that all the "cost of material and labor on contracts which are finished and which had been charged to "Cost of Contract" account are balanced and the account continues to show the amount of labor and material invested in unfinished contracts." This is the part that appears to me of much importance. How many of you, when you are asked by Bradstreets' or Dun's or your bank or your jobber for a statement of how your assets and liabilities stand, could swear to the amount of labor material invested in unfinished work and tell the amount billed against this investment without wanting a day or two to check up.

Another entry is made of the amount charged for a contract. This amount is charged to "Contract Account" and credited to "Finished Contracts."

The result of this entry is that all finished contracts are taken from what appears in "Contract Account" as live contracts, and this account shows now what total of work is actually under way—while the "Finished Contracts" show the total gross profit on all work finished, the cost having been charged and the amount secured being credited.

In writing the above explanation of the bookkeeping entries we make use of to get a true statement of our contracts, I do not give you any idea of the cost of keeping this work straight—yet every one of you will admit that you attempt to do the same thing in your own way. The method as outlined was given to us by a firm of accountants who installed in 1906 the system of tags and records we are using. We have made changes in several details but I have not found anything that will give us the results we want in any other manner. We go a great deal further than the above because we want to know our profit each month and we apportion our overhead expense to each job, using the labor on each job as the best basis on which to figure the expense burden, but I would not advise any of you to attempt to do this. Our business permits me to watch this end of the work and it certainly takes a large portion of expense to get what we get, but we would not change for all the money we have spent.

To show the advantage derived in having one of the firm on the inside all the time, we should say that during the month of February we did $789.40 worth of work on jobs between $10.00 and $50.00 on which we made 55 per cent on our selling price—or 123 per cent on our cost. We also know that on the last 200 contracts we did we charged $43,544. Our cost of labor, material and sundries was $27,325, and our percentage of profit on cost was 59.6 and on selling price 37.2 These results we get by close buying and watching our labor. We would sooner pay a superintendent a large salary and have every move of our $5.00-a-day men count, than pay two $5.00-a-day men to do in their own way what one man with intelligent superintending can do.

BELL ASKS TO BUY PASADENA HOME TELEPHONE.

The Pacific Telephone and Telegraph Company, under the provision of the new public utilities act, has applied to the California Railroad Commission to buy the Home Telephone and Telegraph Company of Pasadena. In the application the Pacific Company declares that it has options on 4,879½ of the total 5,190 of the Home Company shares at $44 per share, and that the total value of the Home plant is $730,0000. The Pacific Company declares that the presence of two companies in Pasadena subjects the people to annoyance and inconvenience and that the City Council suggested the purchase of the Home Company and is in favor of it.

WESTERN LAWS OF ELECTRICITY AND WATER

WATER RIGHT LEGISLATION.

New Mexico, North Dakota, Oklahoma, South Dakota and Oregon.

BY A. E. CHANDLER.

In accordance with resolutions adopted by the legislatures of Oregon and Washington in 1903 a commission was appointed by the governor of each state to draft a water code. As a result of a joint session of the two commissions with officials of the United States Reclamation Service, Mr. Morris Bien, supervising engineer of the Service in charge of land and legal matters, agreed to prepare a draft for the commissions. Mr. Bien's draft was widely circulated in order to receive the benefit of the criticism of many interested in the subject. The corrected draft is generally referred to as the "Bien Code," and although Mr. Bien aimed to take what he considered best from all the existing codes, most closely follows the 1903 Utah statute. It was not adopted in Oregon and Washington but was in North Dakota, Oklahoma and South Dakota in 1905 and in New Mexico in 1907.

Acquirement of rights. As provided in the 1903 Utah statute, applications must be made to the state engineer who, for stated causes, has the power of rejection. Notice of application is published and evidence of interested parties considered. In case of approval the state engineer fixes the time for completion of works and for application to beneficial use, not exceeding five years and four years additional respectively from date of approval. He has the power, for causes stated, to extend such times three years and two years respectively. Regarding the proof of completion of works and application to beneficial use the code follows Idaho.

Adjudication of rights. That part of the code dealing with the determination of water rights is restricted to five short sections. The state engineer makes "hydrographs, surveys and investigations of each stream system * * * obtaining and recording all available data for the determination, development and adjudication of the water supply of the state." Upon completion of survey, the state engineer delivers what data is deemed necessary to the attorney general who enters "suit on behalf of the state for the determination of all rights to the use of such water, in order that the amount of unappropriated water subject to disposition by the state under the terms of this act may become known."

In any suit over water rights all claimants must be made parties and when such suit is filed, the court shall direct the state engineer to make surveys and assemble the necessary data. The aim of the sections is to allow the state engineer to secure a determination of the rights on streams most used for irrigation and also to provide for a complete determination on those streams where suit is entered by private parties.

Distribution of Water. The distribution of water is cared for as in the states previously discussed. The state is divided by the legislature into three or more divisions along drainage lines. A commission is appointed for each division and the commissioners with the state engineer form the board of water commissioners. The state engineer divides each division into districts and the commissioner appoints a water master for each district.

Oregon.

As stated above, Oregon appointed a "water code commission" in 1903, but little was done at the 1905 session of the legislature beyond creating the office of state engineer. In 1907 a second commission recommended the "Bien Code" but it did not pass. In 1909, following the recommendation of a commission which had at its disposal the able assistance of Clarence T. Johnston, then State Engineer of Wyoming, a code was adopted which varies but little from that of Wyoming.

The state is divided into two water divisions with a division superintendent in charge. The two superintendents and the state engineer form the board of control. Contrary to the uniform practice elsewhere all three offices are elective instead of appointive.

The only striking departure from the Washington system is the procedure for defining rights. The sections in regard thereto are almost word for word the Wyoming sections up to and including the determination of rights by the board of control. Instead of considering such final unless appealed from, the Oregon statute provides that a certified copy of the determination and the original evidence shall be filed with the clerk of the circuit court which fixes a time for hearing the determination. The court after the necessary hearings either affirms or modifies the determination of the Board.

A minor difference in the method of adjudication is that the determination in Oregon is initiated not by the board of its own motion but by petition of one or more water users upon the stream. As the board always has before it more petitions for determinations than it can act upon, it is clear that the change in procedure is of no practical importance.

The new legislation adopted in the western states prior to the 1909 statute in Oregon, is silent in regard to riparian rights, although such rights are recognized in Nebraska and the Dakotas. The Oregon statute, however, provides that the use of riparian proprietors shall be limited to the extent of the beneficial use prior to the passage of the act or, where works were under construction at the date of passage, to the amount of water applied to beneficial use in a reasonable time as fixed by the board of control. This part of the statute is of very doubtful validity as it is generally understood that the legislature is powerless to limit a vested right and the riparian right does not depend upon use.

Review of Legislation. In May, 1904, the state engineers of the eight states then having the office formed the Association of State Engineers. The first regular meeting was held at Boise, Idaho, in Sep-

tember, 1904. As a result of a close examination of the provisions of the various statutes it was then agreed that the only difference of importance was in the method of determining rights, and the same view is held today.

In Wyoming, Nebraska and Nevada rights are determined by a state engineer or engineering board, subject to review by the courts on appeal. The method has the advantage of freedom from embarrassing procedure as the officials collect the necessary field data and proofs and are so familiar with the essentials that the irrelevant is summarily eliminated. The rights are accordingly determined with comparative speed and at low cost.

In Colorado, Idaho, Utah, North Dakota, Oklahoma, South Dakota and New Mexico adjudications are made by the courts after the assembling of physical data by the state engineer—except in Colorado where the state engineer has no connection with the adjudication. The chief argument of the proponents of this legislation is that no other method is legally sound. It so happens, however, that the board or administrative method has been upheld by the supreme courts of Wyoming and Nebraska, and the court method has been held unconstitutional in Idaho—the only case in which it has been before the courts (again excepting Colorado).

The constitutionality of the Wyoming statute providing for the new system of defining rights was questioned in Farm Investment Company v. Carpenter (61 Pac. 266) decided May 26, 1900—after the statute had been in operation ten years. The Supreme Court in upholding the statute made the following pertinent statement regarding the efficiency of the two methods:

As between an investigation in the courts and by the board, it would seem that an administrative board, with experience and peculiar knowledge along this particular line, can, in the first instance, solve the questions involved, with due regard for private and public interests, conduct the requisite investigation, and make the ascertainment of individual rights, with greater facility, at less expense to interested parties, and with a larger degree of satisfaction to all concerned.

In the same case it was contended that although the system might be valid for defining rights which had accrued subsequent to the adoption of the constitution, it was certainly invalid for defining rights accruing prior thereto and the Court answered:

It follows from what has already been said that in this regard there exists no difference between claimants whose right accrued prior to, and those acquiring rights after, the adoption of the constitution and the statute in question.

In Crawford v. Hathaway (93 N. W. 781) the validity of the Nebraska statute was atacked and the Supreme Court said:

The Wyoming statute, from which ours is borrowed, has been subjected to judicial construction and is upheld by the Supreme Court of that State on the express ground that the powers authorized therein are not judicial, but administrative. * * * With this authoritative construction of the statute, and decision of the very question raised in the case at bar upon reasoning quite convincing and satisfactory, it would seem that the question should be regarded as at rest. The primary object of the board is for the purpose of supervising the appropriation, distribution and diversion of water. This is obviously an administrative rather than a judcial function.

In Bear Lake v. Budge (75 Pac. 614) the Idaho Supreme Court held invalid that part of the 1903 statute providing for the initiation by a water commissioner of suits to determine water rights, in the following words:

Said provision also violates the provision of our statutes which requires suits to be brought in the name of the real party in interest. The water commissioner, a public official, is not the real party in interest in a suit to quiet title or to determine adverse interest in property not claimed by or belonging to him or the state.

The new Oregon method is designed to meet the objections of those who contend that only a regular judicial tributnal should establish water rights. As stated above, the 1909 Oregon statute provides for an immediate affirmance or modification of the determination of the board by the circuit court. Regarding this feature Mr. Lewis, State Engineer of Oregon, in his third biennial report (1909-1910) states:

It is doubtful if the requirement of a confirmation by the court strengthens the water code. On the other hand it is argued that this simply prolongs the proceeding unnecessarily and that the determination of the board, the members of which are supposed to have a special and technical knowledge of the conditions involved, should be final without the intervention of the court, except upon appeal. It is also argued that such appeal should only be allowed to the Supreme Court thus saving the delay occasioned by taking the matter first into the Circuit Court and then to the Supreme Court.

Acquirement of Rights. It has been stated that the following states have state engineers to whom applications on furnished printed forms must be made by intending appropriators: Wyoming, Nebraska, Idaho, Utah, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota and Oregon. The state engineer of each of the above states will send an application blank and instructions on request and every intending appropriator should follow the directions carefully and rigidly and thus avoid later trouble. To the above list Colorado should be added as the state engineer there issues instructions regarding maps and statements to be filed within sixty days after the commencement of surveys or actual construction of any ditch or reservoir.

Texas requires the filing of a map and statement within 90 days after commencing construction, in the office of the county clerk of the county where headgate is situated.

The remaining western states, Arizona, California, Kansas, Montana and Washington still follow the crude practice of posting notices.

At the close of the first paper of this series an example of a California water notice, accepted by the Supreme Court, was given to show how little definite information need be stated in the notice to meet the requirement. The following form of notice has been used by the United States Reclamation Service in the states last mentioned and with slight changes and omissions can be adapted to any case.

Form of Notice of Water Appropriation.

.... claims at the point where this notice is posted, all the unappropriated waters of the .... River, both surface and underflow, more specifically stated as amounting to ..... cubic feet per second*

This notice is posted on . ... 190....., on a...... tree on the .. bank of the .... River, in Sec. ....T...... R ....M., at a point distant......

feet and bearing .... from the........ corner of said section.

The water is to be used for irrigation, domestic, power, mechanical and other beneficial uses in and upon lands situated in .... counties and located in the following townships ....

The water hereby appropriated is to be stored by means of a dam located in Sec. . . . T . . . R. . . . in a reservoir located in Ts..........R..........and will be conducted to the points of intended use by means of canals, flumes, pipes, tunnels, or other appropriate means of conveying water, of the following dimensions and grade as will give capacity of .... cubic feet per second.

*In California the amount should be stated in inches under four-inch pressure.

In Arizona the territorial laws (first state legislature now in session) require that a copy of the notice must be recorded in the office of the county recorder of the counties in which the ditch lies and also in the office of the Secretary of the Territory—no time limit is specified. In California and Kansas, a copy of the notice must be filed in the office of county recorder (county clerk in Kansas) of the county where posted in ten days and work must begin in 60 days. In Montana a verified copy must be filed in the office of county clerk of county where posted in 20 days and work must begin in 40 days. In Washington a copy of the notice must be filed in office of county auditor of county where posted in ten days and work on storage works must begin within three months and on diversion works within six months. In Montana, in case of appropriation from adjudicated streams, the new appropriator within 40 days after completion makes application to clerk of district court who orders an examination by a competent engineer. A hearing after published notice is held and the court limits the appropriation in accordance with its findings. The procedure was adopted in 1907. Montana has had a state engineer since 1903 but his duties are confined to operations under the Carey Act. In view of the simple procedure in regard to the acquirements of rights existing in other states having state engineers the Montana innovation is both inexplicable and inexcusable. Any logical procedure should precede construction and not follow it.

Aside from the information and warning regarding the amount of unappropriated water an intending appropriator receives in the states requiring applications to a state engineer, he is materially assisted by definitely knowing the time limit for construction and application to beneficial use. In the states allowing the posting of notices the statutes merely provide that the right shall relate back to the date of posting if the work is completed with reasonable diligence—to determine which, in case of conflict, means litigation.

Instances do not often arise where the state engineer is called upon to reject an application for the reason of probable detriment to the public welfare. As previously stated this authority was given to the state engineer by the 1903 Utah statute but was interfered with by the district court and was repealed in 1905. In the recent Oregon case of Cookinham v. Lewis (114 Pac. 88), decided Mar. 7, 1911, the provision of the Oregon 1909 statute authorizing the state engineer and board of control to reject an application where the proposed use is a "menace to the safety and welfare of the public" was upheld. It is noteworthy that Utah, which was originally characterized by centralized authority, should deny this power to a state official, and that Oregon, where the practice is so new and so foreign from that which preceded, should uphold it.

Water rights initiated by application to the state engineer are based upon beneficial use and perpetual unless abandoned or forfeited through nonuse—as was the case prior to the adoption of the new legislation. The only exception is the right for power purposes which has been limited in California (1911) and Oregon (1909) to a forty year term and on which an annual tax depending upon its magnitude is levied. The legislation regarding power rights will be considered in a later article dealing with rights of way over public land.

Conclusion. It should be emphasized in closing that the "new legislation" which has been discussed is dictated solely by good business sense. Instead of endless litigation regarding existing rights and no system worth considering regulating new appropriations, as in California, the new plan provides a full determination of existing rights in a single proceeding, the proper distribution of water by state officials according to such determination, and a complete control of the acquirement of new rights by a central office. It rests upon the same legal basis as the old and in no way attempts to interfere with or limit vested rights. It is applicable to any condition of topography or climate, as is illustrated by its acceptance by Nebraska in the east and Oregon in the west, by North Dakota in the north and New Mexico in the south. It leads the way from chaos and strife to order, harmony, and efficiency.

THE VELOCITY OF LIGHT USED TO SIMPLIFY VOLTAGE REGULATION COMPUTATION.

BY R. S. BROWN.

The exact calculation of voltage, current and power at the end of an alternating current transmission line can only be made by the use of the exact equations, deduced by the infinitesimal calculus, which treat the line constants, resistance, inductance and capacity, as uniformly distributed along the line. In these equations all the quantities concerned are vectors and the equations involve hyperbolic functions of the angle $\beta = \sqrt{ZY}$, expressed in radians. Their form is as follows:

$$e_g = e_r \cosh \beta + I_r Z \frac{\sinh \beta}{\beta}$$

$$I_g = I_r \cosh \beta + e_r Y \frac{\sinh \beta}{\beta}$$

Where,

e_g = Star voltage at generator.
e_r = Star voltage at receiver.
I_g = Star current at generator.
I_r = Star current at receiver.
Z = Total impedance per wire of line.
Y = Total admittance per wire of line.

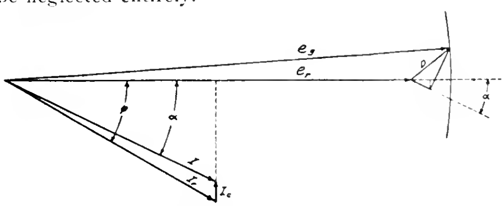
By the aid of tables of cosh β and sinh β, the application of these equations is not especially difficult, although it involves quite a bit of numerical work.

For the engineer, however, who is more accus-

tomed to dealing in powers of numbers than hyperbolic functions, the terms involving these functions may be expanded into a series containing powers of ZY and all the terms of these series beyond the first or second neglected as being of minor magnitude. By means of such an approximation the voltage equation becomes

$$e_g - e_r \left(1 + \frac{ZY}{2}\right) + Z I_r$$

This would be the exact equation for voltage if all the capacity of the line were collected into two equal lumps and one lump placed at each end of the line. This fact has given rise to the so-called "split capacity" treatment of the subject. Such approximation for lines not exceeding one hundred miles in length gives results close enough for most purposes, the error introduced in the voltage regulation thus found not exceeding 2 per cent. This approximation has the added advantage that if the power factor of the load be replaced by the power factor of the load combined with the condenser, which is assumed to be in parallel with it, the condenser may thenceforth be neglected entirely.



Vector Diagram Voltage Regulation

The method of correcting the load power factor on this basis may be seen by referring to the accompanying diagram. The load component of I_r is $I_r \cos\phi$ and the wattless component, $I_r \sin\phi$.

$$I_g = \frac{1}{2} Y e_r = \frac{1}{2} \omega C e_r$$

$$\tan\alpha = \frac{I_r \sin\phi - \omega C e_r}{I_r \cos\phi}$$

$$\tan\alpha = \tan\phi - \frac{\omega C e_r}{2 I_r \cos\phi}$$

But $P = \sqrt{3} E_r I_r \cos\phi$

Where $E_r = \sqrt{3} e_r$ = delta load voltage.

$$\text{Hence } \tan\alpha = \tan\phi - \frac{\omega C E_r^2}{2P} \quad \ldots\ldots\ldots\ldots (1)$$

The capacity, C, may be eliminated by means of the relation which holds between inductance and capacity of aerial circuits.

$$L C = \frac{l^2}{V^2} \text{ or } C = \frac{\omega l^2}{X V^2}$$

where V is the velocity of light, taken at 183,000 miles per second and l is the lengths of the line in miles. Applying this relation to equation (1) we get

$$\tan\alpha = \tan\phi - \frac{\omega^2 l^2 E_r^2}{2 V^2 X P} \quad \ldots\ldots\ldots\ldots (2)$$

For most purposes the use of vectors may be dispensed with entirely on the assumption that the locus of the voltage vector e_g is a vertical straight line instead of an arc. If the voltage regulation does not exceed 10 per cent and the angle made by D with e_r does not exceed 45 degrees the maximum error thus introduced will not exceed 4 per cent. This assumption gives

$$e_g = e_r + r I \cos\alpha + X I \sin\alpha$$

and the regulation will be

$$R = \frac{e_g - e_r}{e_r} - \frac{\sqrt{3} I \cos\alpha}{E_r} (r + X \tan\alpha)$$

or,

$$R = \frac{P}{E_r^2} (r + X \tan\alpha) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The percentage power loss will be,

$$S = \frac{3 r I^2}{P} = \frac{P_r}{E_r^2 \cos^2\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The regulation, using ϕ in place of α, will be,

$$R_1 = \frac{P}{E_r^2} (r + X \tan\phi) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Subtracting (5) from (3)

$$R - R_1 = \frac{P}{E_r^2} (X \tan\alpha - X \tan\phi)$$

and from equation (2),

$$R = R_1 - \frac{\omega^2 l^2}{2 V^2}$$

for sixty cycles,

$$R = R_1 - .00000212\, l^2$$

That is to say, the voltage regulation of the line may be found by first finding the regulation neglecting capacity entirely by means of equation (5) and then correcting for capacity effect by subtracting $.00000212\, l^2$.

From this it is seen that the no load regulation of any line is approximately, for sixty cycles,

$$R_0 = -.00000212\, l^2$$

The results obtained by this method will not be in error by more than about 5 per cent for lines less than one hundred miles in length if the current at the load is not leading with respect to the load voltage.

Example: $P = 1000$ K.W., $E_r = 40000$ V., $\cos\phi = .85$, $\tan\phi = .62$, $l = 100$ miles, $X = 100$ ohms, $r = 80$ ohms.

Solution: From equation (5) neglecting capacity entirely, $R = .0935$. Correcting for capacity, $R = R_1 - .0212 = 7.23$ per cent. From equations (2) and (4), $S = 6.5$ per cent.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year.	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

High Pressure Water Supply

It is an attribute of a brave people who have successfully passed through a calamity which tried the souls of men that reference to the incident be shunned. Undoubtedly those who saw the soul-harrowing scenes accompanying the sinking of the Titanic, now that the first days of gasping and stunning are over, prefer not to allude to it again.

But the grim experiences of the past cannot be overlooked. The San Francisco fire,—like the sinking of the great unsinkable monster of the sea, the Titanic,—brought its lesson. In the memorable catastrophe of 1906 the rupturing of the city mains in some eleven separate points made it impossible to have relief from the on-rush of the devouring element. After studying all conditions attending the three days' burning of the western metropolis, a committee of engineers recommended the installation of an auxiliary salt-water high-pressure system which, it is believed, will safely perform its protective function should the city ever again be visited with a disaster similar to that of 1906.

A building of steel arches, sufficient in strength to withstrand the tumbling across its roof of a modern sky-scraper, houses this equipment. Steel shutters, ready to be unrolled at an instant's notice, have been designed to make every window and door fire-proof from possible disaster without. Finally, though within the heart of the city, this isolated fireproof steel cage, by means of its sunken oil tanks and water containers, is maintained in readiness to keep the powerful pumps working for three days without supply from the outside world. Double sets of mains supplying a net work of interconnected pipes in the business district of San Francisco would seem to make the new city of steel and concrete as safe from fire as modern genius and enterprise of man could contrive.

The one distressing thing about the whole affair is, however, that this beautiful equipment, aggregating an outlay of $500,000, should not be put to some useful work during the years and years it may perforce be idle awaiting a possible recurrence of the disaster of 1906. It would seem that the engineers in charge should advise the installation of a steam turbine of sufficient capacity to meet the output of the boilers in the new station and thus grind out power for the Geary street road and other municipal undertakings. This turbine should have fireproof housing the same as the other equipment, for in time of great public disaster a supply of power in the days immediately following may not be entirely out of demand, as was shown to be true six years ago.

Regulation and the Golden Rule

Scarcely a city on the Coast has passed through the recent years without heated discussion upon regulation of corporations serving the municipality in the way of heat, light, power or water, and especially have those corporations engaged in telephony or electric traction been brought into the public lime-light of investigation. The campaign usually opens by a sublime indifference on the

part of corporate interests on the one hand pitted against the blood-thirsty agitator on the other. Not infrequently when the smoke of the first scrimmage clears away, the result turns out as it did in Los Angeles a year ago, in which a group of disinterested experts determined upon a fair and equitable rate, only to have the results of their labor arbitrarily cast aside by the city council and a rate of their own making instituted therefor. At present Portland seems to be engaged in a merry fight as to reduction in city street railway fares in which it is proposed to sell six fare tickets for twenty-five cents. The whole agitation, after all, should be an economic one, a discussion in which the highest dictates of justice and reason should predominate.

In this second stage of control in public utilities now with us, a saner, fuller realization of justice has come to all parties to the issue. The country over, big men—some representing the people, others the corporate interests—have come to look upon regulation in a new light and all have come to a fuller realization of responsibilities at issue. The principles of the golden rule are becoming more and more useful in solving these intricate problems.

If a modern Moses were to come to earth bearing tablets with chiseled commandments, it is not improbable that the ten dictates to the corporate interests would indelibly spell "regulation," while those given

To the Utility Company

I.

Render good, adequate and continuous service.

II.

Establish fair and reasonable rate schedules.

III.

Give no discriminating rates to customers of the same class or between classes of customers for like service.

IV.

Urge upon your executives the necessity of a broad and liberal business administration.

V.

Let strict obedience to the law and no participation in politics be your motto.

VI.

Advance with the growth of the community, extend service into all populated sections of the municipality and suburbs and make an earnest endeavor to market the greatest possible volume of service.

VII.

Thoughtfully consider the march of invention and adopt approved types in machinery and apparatus, observing at all time a high standard of physical maintenance.

VIII.

Inculcate sound financial management throughout.

IX.

Observe a public spirited attitude in all matters concerning the general welfare and advancement of the community.

X.

Never break faith with the people in agreements, promises and announcements.

to the public would have emblazoned in brilliant outline the motto of our forefathers, the "golden rule."

In view of the discussion of prominent men representing all interests the following suggestions compiled from numerous views emphatically summarize the issue and the give-and-take to be maintained by both parties:

To the People

I.

Give to the public utility company the same degree of confidence, encouragement and respect that one business man may accord to another, that any citizen expects from his neighbor.

II.

Openly permit a fair profit on the capital, energy, ability and risks embodied in the undertaking and willingly permit a profit greater than mere interest that could be obtained without effort or hazard.

III.

Loathe attacks upon corporation management by popularity seeking agitators and demagogues.

IV.

Do not fail to recognize and reward improvements in service on the part of the public utility corporation.

V.

Earnestly recognize the fact that the operation of utilities differs fundamentally from merchandizing or manufacturing.

VI.

Never be unreasonable in demanding large capital outlay for improvements not strictly necessary to the rendering of adequate service, such as placing wires underground in cities of small or medium size.

VII.

Remember to pay your bills promptly, for the company cannot render the service demanded of it if its only source of income is retarded.

VIII.

Utilities must be protected against direct competition for all authorities agree that public utilities can be conducted with greatest benefit to the public as controlled monopolies.

IX.

Let legislation—municipal, state and national—be considered with the greatest care, and give a just recognition of the fact that, starting from a given base line, which varies in different localities, reductions in rates can be secured without financial loss only by increasing the volume of service sold.

X.

Encourage the utility company in attaining reasonable prosperity for new capital will never enter a dead field; treat all questions affecting public utilities in a fair-minded way, looking upon them as business question without regard to political considerations.

If now in addition both utility corporations and public alike follow toward each other the New Testament adage, "Love thy neighbor as thyself," worlds of good will continue to follow when both parties consider in their innermost whether or not the dictates of justice and equity impel their motives.

PERSONALS.

F. G. Baum, consulting engineer at San Francisco, left for a month's trip East this week.

A. E. Beck, who is interested in the electric street railway lines in Vancouver, is at San Francisco.

A. G. Jones, sales engineer with the General Electric Company, has returned to San Francisco from the East.

Albert Sechrist, a gas and electric supply dealer of Denver, is among the recent arrivals at San Francisco.

John M. Gardner, who has electric railway and lighting interests in Southern California, has been spending a few days at San Francisco.

E. A. Wagner, who is in charge of the transformer department of the Fort Wayne Electric Works, has returned to the factory after visiting California.

F. A. Cressey, who has electric lighting interests at Modesto, returned to California during the past week with an excursion party from the canal zone.

H. C. Goldrick, Pacific Coast representative of the Kellog Switchboard & Supply Company, spent the past week on a business tour of Northern California.

J. B. Mills, who is in charge of the Fort Wayne Electric Company's department of meter manufacture, has returned to Fort Wayne, Indiana, from California.

John S. Eastwood, engineer in charge of the construction of the Big Meadows dam for the Great Western Power Company, spent the past week in San Francisco.

W. D. Ward of the Pelton Water Wheel Company's sales corps has returned to San Francisco from Tahiti, where he closed the contract for a water-wheel installation.

J. W. White, manager of the Vix Engineering Company, who recently went to Chicago, will spend about a month in visiting the factories at Fort Wayne and elsewhere.

Frank Blossom, of the firm of Sanderson & Porter, of New York, spent the past two weeks in Arizona on business connected with properties owned or controlled by his firm.

J. J. O'Connell, who has been engineer in charge of the Pacific Power & Light Company's construction work at Tygh Valley, Oregon, has joined the engineering staff of the Electric Bond & Share Company at New York City.

James D. Mortimer, who has been vice-president of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., has been elected president of the company to succeed Mr. James Campbell, who has been elected chairman of the board of directors. Mr. Mortimer graduated from the college of mechanics at the University of California in 1900 and was at that time awarded the class medal as the most distinguished student of the year.

J. A. Roosevelt has resigned his position as master of transportation for the British Columbia Electric Railway Company, Ltd., at Vancouver, B. C. **Allan Purvis** has been appointed manager of the interurban lines of the company. The position of local managers of interurban divisions has been abolished. **W. H. Elson** has been appointed superintendent of two of the company's interurban divisions. **E. Sterling** will be in charge of the other two divisions. **J. B. Rannie** has been appointed traffic agent in charge of the company's system in Vancouver and suburbs.

J. W. E. Taylor, late of New York and Colorado, was recently appointed to take charge of the Big Bend extension of the Great Western Power Company. Mr. Taylor, who has had wide experience in construction of this kind, already has one hundred men at work at the Las Plumas plant. Two vertical generating units, with a maximum rating capacity of 25,000 kw. each, are to be installed in the plant when completed. Representatives of several of the leading water wheel manufacturers are expected at San Francisco before June 1st to confer with the Great Western management as to water wheel designs.

MEETING NOTICES.

The annual meeting of the Portland Section of the American Institute of Electrical Engineers was held in the Assembly Hall of the Eectric Building, Tuesday, May 21, 1912. H. E. Eisenmenger, of the National Electric Light Association, gave a talk on "The Theory and Space Representation of Electric Service Rates." To clearly show the space represenation of rates Mr. Eisenmenger exhibited a number of interesting models of rates of Western cities.

The Los Angeles Section of the American Institute of Electrical Engineers met at the Hotel Hollenbeck on May 21, 1912. J. E. Macdonald presented a paper on "Practical Joint Pole Construction."

AMERICAN ELECTRIC RAILWAY ASSOCIATION OFFICIALS AT SEATTLE.

The representatives of the American Electric Railway Association who are making a trip throughout the country, arrived at Seattle May 15, where they inspected the Puget Sound Traction, Light & Power Company. The main feature of the entertainment was a banquet given at the Rainier Club by Jacob Furth. An address of welcome was given by Mayor Cotterill and speeches made by President T. M. Carter, O. T. Crosby and C. G. Pierce of the Association. Those present, in addition to the visitors from the East, were Mayor Cotterill, Senator John L. Wilson, A. J. Blethen, Scott C. Bone, Councilman A. F. Haas, A. J. Goddard, J. G. Peirce, Max Wardall and Charles Marble, Superintendent of Public Utilities A. L. Valentine, Samuel H. Piles, J. D. Lowman, J. B. Howe, L. H. Bean, W. W. Wilshire, W. E. Best, E. G. Anderson, D. C. Barnes of Everett; G. P. James, M. Ramsdell, L. S. Winan, G. A. Richardson, George Carson, E. C. Gamnitz, A. D. Campbell, G. H. Richardson, H. T. Edgar, T. A. Shackleford of Tacoma, Joseph Schaefer, A. S. Michener, E. G. Shorrock, C. L. Francis, F. Dabney, L. R. Coffin of Bellingham, G. B. Harrington, E. A. Batwell, George James, W. J Grambs.

STATE ELECTRICAL CONTRACTORS' NOTES.

The Turner Company have been awarded the wiring on an apartment house on the corner of Bush and Leavenworth streets.

W. S. Hanbridge, secretary of the California State Contractors, was in San Jose Tuesday arranging for the State Convention.

A. W. Bullard, vice-president and general manager of the Great Western Power Company, gave a dinner to the members of the Electrical Contractors' Association last Friday evening at Techau Tavern. This is the third of a series of dinners that have been inaugurated through the California State Association of Electrical Contractors in an effort to bring about closer relations between central stations and contractors.

Only one more week is left for the competitors to get their answers in to be able to win the contractors' schedule prize.

The Federal Electric Sign System now occupies a new store at 38 Fifth street. The Federal agency was formerly carried on by the late H. F. Frosch.

P. G. Jones, formerly of Hand & Jones, representing the Reliable Electric Company and the Automatic Electric Company, both of Chicago, is now located at 633 Howard street. He handles telephone specialties, principally made by the above companies.

PLANS FOR THE ENTERTAINMENT IN SOUTHERN CALIFORNIA OF THE BOSTON AND NEW YORK DELEGATES TO THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

The De Luxe trains carrying these delegates will arrive from the Grand Canyon at Riverside at 7 a. m., Saturday, June 1st. After breakfast at Mission Inn, automobiles will be provided for rides to Rubidoux and Victoria Hill and incidentally delegates will be entertained at one of the great orange groves, where they will be allowed to pick oranges from the tree.

The party will return to the Mission Inn for lunch, after which they will be taken over a beautiful twenty-mile drive to Ontario, where they will visit the great plant of the Pacific Electric Heating Company, where light refreshments will be served. From there by automobile to Uplands, where their train will be found waiting for them, and thence to Los Angeles by way of Pasadena, arriving in Los Angeles at 5:05 p. m., and go direct to the Hotel Alexandria.

At 8 o'clock on the same evening, a reception will be tendered by the Los Angeles Chamber of Commerce, assisted by the Los Angeles Section of the American Institute of Electrical Engineers and the Architects' and Engineers' Association of California at the Chamber of Commerce Building.

On Sunday morning, the party will take special trains through Pasadena for Mount Lowe and Alpine Tavern, where a wonderful view of Southern California will be obtained and a good luncheon served. Returning, the party will stop at the Ostrich Farm and arrive in Los Angeles at 5 p. m.

On Monday, the party will take special electric cars via Hollywood, Sawtelle, Soldiers' Home, to Santa Monica, where a short stop will be made; thence to Venice, where another short stop will be made; thence via Playa Del Rey to Hermosa, where the plant of the Pacific Light and Power Corporation will be visited; thence to Redondo Beach; thence by way of Watts to Long Beach, where luncheon will be served at the Hotel Virginia at 12:30 p. m. After lunch take special cars to the Edison Company's new steam plant, where an hour will be spent. Then return by way of Wilmington to Los Angeles, arriving at 4:40 p. m.

The party will continue its journey to San Francisco by way of Santa Barbara and Del Monte on Tuesday, June 4th. The party will be the guest of the Los Angeles Gas and Electric Corporation, Pacific Electric Railway, Pacific Light and Power Corporation, and Southern California Edison Company.

LOS ANGELES ELECTRICAL LEAGUE.

The regular weekly luncheon of the Los Angeles Electrical League was held at the Hotel Hollenbeck, Tuesday, May 21. There was a large and enthusiastic attendance of members, the three invited guests being Franklin Booth, C. J. Balbour and E. B. Strong. T. E. Burger presided and called upon E. B. Strong to tell about the Golden Poppy Special train to the Seattle convention of the National Electric Light Association. One car has already been reserved from Los Angeles and there is a strong likelihood that another will be taken by the southern delegation. An adaress on "Commission Form of Government" was given by Mr. Lewis Works, one of the most interesting speakers by whom the League has been favored. Visitng electrical men are welcome at these meetings and invited to attend.

TRADE NOTES.

The Allis-Chalmers Company has sold to the American Falls Light & Power Company, at American Falls, Idaho, one 5500-h.p. Allis-Chalmers turbine water wheel. It will operate under a head of 45 ft., being direct-connected to a General Electric generator.

Chas. C. Moore & Company, engineers, have been awarded the contract for the immediate construction of a power and light plant for the C. H. Smith Lumber & Manufacturing Company of Marshfield, Ore., for the purpose of generating light and power for the operation of its plant.

The Allis-Chalmers Company has been awarded the contract for two 9000-h.p., spiral-case waterwheels for the Northwestern Electric Company. These wheels are to be direct connected to two 6000-k.v.a generators and installed in the Pacific Northwest to supply current for transmission to Portland, Ore.

The Northwestern Electric Company, which is preparing to install a hydroelectric plant at White Salmon, Wash., for the transmission of power to Portland, Oregon, recently opened an office at Room 805 California Pacific Building, 105 Montgomery street, San Francisco. Mortimer Fleishhacker is the managing director.

The business of the Crocker-Wheeler Company is increasing so rapidly on the Pacific Coast that J. E. Fries has been transferred to the San Francisco office as Pacific Coast engineer. With this addition to the present organization, prompter service than ever can be given to current inquiries. On April 1st, the company opened an office in the Title Insurance Building in Los Angeles, Cal.

The Westinghouse Electric and Manufacturing Company has sold to the Southern Pacific Company nine additional electric locomotives of the same type as the one sold several months ago for use on the Alameda County electric system. These 60-ton locomotives are the largest ever built for use with 1200-volt current and they are to be fitted with Westinghouse Type H. L. controllers. It is understood that four of the locomotives will be sent to Portland, one to San Jose, one to Los Angeles, and the remainder to Oakland.

The engineering department of the National Electric Lamp Association, which is sustained by certain works of the General Electric Company, will maintain an elaborate exhibit at the Electrical Show held in conjunction with the National Electric Light Association Convention at Seattle, Washington, June 10th to 13th. Booths 45, 46, 53 and 54, which are prominently located in the exhibit hall, have been reserved. The exhibit. will consist of a complete line of National Quality Mazda incandescent lamps and some of the apparatus used by the engineering department in its testing laboratories. The main feature of the exhibit will be a large metal fixture, finished in statuary bronze, bearing six rows of branches from which various sizes of Mazda lamps fitted with reflectors are suspended. The fixture is about 10 feet in height and is surmounted by a 500-watt lamp. Mr. Ralph Beman, director of technical publicity of the engineering department, National Electric Lamp Association, will be in charge of the exhibit.

CENTRAL STATION PUBLICATIONS.

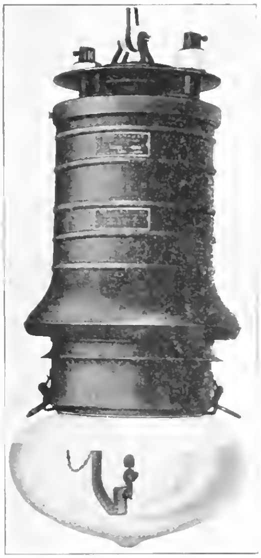
The Pacific Gas and Electric Company is distributing among consumers an attractive pocket pamphlet on "The Electric Meter, How to Read It, and Its Relation to Efficient Illumination."

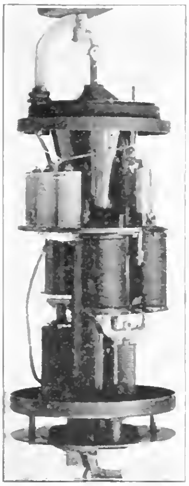
"Edison Current Topics" from the Southern California Edison Company of Los Angeles, makes its initial monthly appearance with the May, 1912, issue. The first number contains several articles and many personal items which should be of great assistance in creating a closer co-operation and harmony among the employes of this great company and great credit is due to the progressive officials for its inception and to its able editor for its excellence. The leading article is a masterly contribution on "Public Regulation" by Geo. A. Damon. "With knowledge of the intelligence and vesratility and enthusiasm of Edison men, we predict for Edison Current Topics a bright and useful career" finds responsive affirmation.

INDUSTRIAL

SERIES METALLIC FLAME ARC LAMP.

The intense white light, resembling daylight, and the long life of electrodes and high efficiency, make metallic flame arc lamps particularly desirable for the lighting of streets, railroad yards, and other large areas, where series circuits are generally used because of the large saving in copper thus obtained. In the metallic flame arc lamps manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., the value of these desirable features is enhanced by the excellent distribution of the light, obtained by the clever allocation of the electrodes and reflectors. This is such as to produce uniform illumination; there is no intensely bright spot directly under the lamp, and no shadow rings. Most of the light is emitted at a wide angle, so that a large area is uniformly lighted.





Westinghouse Series Metallic Flame Arc Lamp

The high efficiency of metallic flame lamps is due to the fact that not only the end of one electrode is luminous, as in the carbon arc, but the entire arc flame emits a bright light, owing to the presence of the volatile.

In the Westinghouse lamps the vapors produced by the metallic oxides, of which the electrodes are composed, are not permitted to come in contact with any solid substance in the lamp chamber, and therefore do not deposit as soot. The construction is such that air currents pass down over the inner surface of the globe and down along the electrodes, then out through a chimney. These air currents serve to carry off the vapors and soot, and also to steady the arc so that it does not run up the side of the upper (negative) electrode.

The negative electrode is on top, so that most of the light is thrown downward, as the brightest part of the flame is near the negative electrode. A reflector directs downward the small part of the light emitted above the horizontal, and the globe is so designed that reflections from it are in a downward direction. The lower electrode is stationary, and the upper electrode feeds, maintaining the arc always within half an inch of the same position.

The feeding mechanism is entirely free from floating parts, and is remarkably simple and rugged. When the lamp is out, the upper electrode is held away from the lower, and the cut-out contacts are closed. All magnets and electrical parts are of generous size, and easily removed. The starting resistors are wound on grooved spools, and are of special wire that does not become brittle or granular. The cut-out is extremely simple and reliable, and has carbon and copper contacts. A non-sticking dashpot with self-lubricating graphite plunger, damps the armature of the feeding magnet. The clutch is a hardened steel punching, similar to the clutch commonly used in carbon arc lamps.

The simplicity of the lamp contruction makes very few insulated parts necessary. Only solid mica and porcelain insulation are used. Each lamp is tested at 3000 volts alternating current for one minute before shipping.

The frame consists of heavy metal punchings, and is therefore practically unbreakable, yet light in weight. The main portion of the frame is formed by the chimney tube, hung from a heavy, punched cap, which carries the two terminal posts and the hanger.

A loop of non-corrosive metal, reinforced at the top, where wear is greatest, provides means of suspension. This loop encircles a porcelain insulator that is held in a punched sheet yoke with a heavy cotter pin.

Two-screw binding posts drilled for No. 4 wire are held securely in porcelain insulators, the square shanks of these posts preventing twisting.

The case is formed from heavy, black-finished copper. It is of the entirely removable slip type, and is secured in place with a three-point bayonet joint at the top. A knurled machine screw, inserted through the case near the top, and turned into a hole in the frame, effectively locks it in position. The case can be locked in any one of the three positions at which the bayonet joints will engage. When the case is taken off the entire lamp mechanism is exposed and rendered very accessible for inspection.

Two types of case are furnished for these lamps, one using a flat globe, which is used principally for the outside illumination of buildings, as it does not throw a shadow on the front of the building, and the other is used for ground illumination, as all light is thrown below the horizontal.

A mixture of metallic oxides forms the upper (negative) electrode, and the lower (positive) electrode is a composite metal button. The upper electrode is 16 inches long and approximately one-half inch in diameter. Both electrodes are changed at each trimming.

The positive electrode is held on a goose-neck casting, so arranged that it can be swung to one side when inserting the negative electrode. The negative electrode is held in a split bronze sleeve having a stem with a flexible conductor attached to its upper end. This holder slides in a guide tube, which protects the holder from fouling, due to deposit of the arc vapors, and is also arranged to prevent twisting.

All Westinghouse metallic flame arc lamps are adjusted before shipping, for a seven-sixteenths inch arc length, which will ordinarily give an average terminal voltage of 68. Two different styles of each type can be furnished. One is adjusted for a current of 4 amperes and the other for 6.6 amperes. The same lamp cannot be adjusted for both currents. Two adjustments are provided, one for the length of the arc and the other for maintaining the voltage across the arc at its normal value. The length of arc is adjusted by means of a screw that permits the electrodes to be so spaced as to obtain a normal arc voltage. The shunt cut-out adjustment limits the voltage of the lamp to a predetermined maximum.

GREENFIELDUCT.

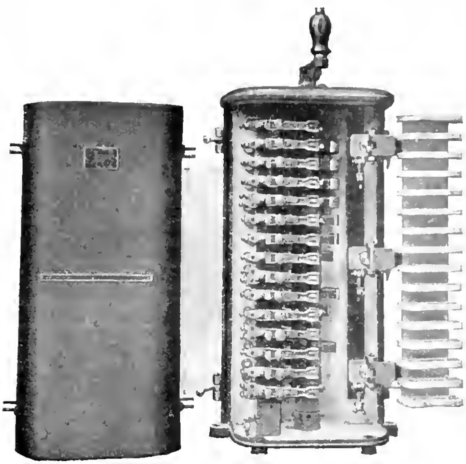
The Sprague Electric Works of General Electric Company, New York City, has recently placed on the market a Rigid Iron Conduit known to the trade as Greenfielduct. It is claimed by the manufacturer that Greenfielduct possesses advantages over all other types of rigid iron pipe, due to the fact that it is treated with hot galvanizing on both the interior and exterior surfaces, the process being such as to afford a standard sulphate of copper dip test equivalent to seven or more dips.

Greenfielduct.

The reputation which Greenfield B cable has achieved is due largely to the treatment of the steel armor with molten zinc, and as BX cable has been found to wear unimpaired under conditions which might otherwise have resulted in rusting of the armor, there is every reason to conclude that Greenfielduct, having a similar hot galvanized finish, will prove equally serviceable.

NEW A. C. MOTOR STARTERS AND SPEED REGULATORS.

The accompanying illustration shows the general construction of a new line of starters and speed regulators for a.c. slip-ring induction motors, built by The Cutler-Hammer Manufacturing Company, of Milwaukee. As will be noted, the drum is similar in appearance to the d.c drum controllers brought out last year. The same kind of non-stubbing, straight-line contact fingers are used. An arc-proof shield is mounted under the finger board, and so slotted as to interlace with the deflectors, preventing burning of the board and communication of arc from one finger to another. The operation is with an easy and smooth rotary motion. With the starter the resistance is entirely cut out of the rotor circuit when running normal, while with the speed regulator the operating handle may be moved backward or forward, according to the variation in speed desired. Standard regulators are arranged to give 50 per cent speed reduction. The resistance used with these controllers varies according to the duty—whether for starting only or for regulating. The cast metal grids are mounted in special mill-end frames on two supporting rods. These rods are covered with mica tubing and are also insulated from the end frame by fibre washers and tubes.



Cutler-Hammer A.C. Motor Starter and Speed Regulator.

WESTERN ELECTRIC'S BUSINESS.

Total of goods billed out during April by the Western Electric Company shows the surprising increase of 17 per cent over the total for April, 1911. Last month's gain slightly more than offset the falling off shown by the first two months of this calendar year. March ran about even with the preceding March, so that the first four months of 1912 are about 1½ per cent ahead of the same four months in 1911.

April's gain is looked upon by the company's officials as somewhat extra-normal and due to several special conditions. It indicates an increase in the year's total business which later months, it is believed, will not sustain. Those close to the company say that if 1912 shows as good business as last year, when sales totaled $66,000,000, they will be well satisfied with the result.

The gain last month came chiefly from the East and the West sections of the country. The Middle West was somewhat behind, reflecting the cold weather and late spring. Later it is expected that the Middle West will make the lost ground, provided crop developments continue satisfactory.

This is the busy season of the year for the Western Electric Company. The telephone, electric light and power companies are overhauling their plants and going ahead with extensions and improvements. The months of April, May and June usually see the largest volume of goods billed. Foreign business was also an important contributing factor to the April improvement.

Western Electric is contemplating no construction work of importance. The Hawthorne plants are completed and the company has sufficient facilities to care for the present volume of trade and considerable in addition. Number of employes continues about the same as a month ago.

Reports from the company's salesmen throughout the country are generally optimistic. No great expansion in the electrical industry seems at hand, but that it is not falling behind is indicated by the Western Electric's returns for the year to date.—Taken from May 14th issue of Wall Street Journal, New York City.

ELECTRICITY—THE SERVANT IN THE HOUSE.

A great deal has been said and written about the electrical home of the future; but it has remained for the Western Electric Company to point out, in their recently published booklet, entitled, "Western Electric Household Helps," that the electrical home is a thing of the present.

The booklet is a most attractive one and, being dedicated to the American woman, it has been the aim to produce something which would appeal to the housewife by virtue of its delicate appearance and engagingly written subject matter. The finished publication is evidence that this aim has been achieved. The booklet shows conclusively that with electricity in the home, the much-dreaded housework and house cleaning may be shorn of their terrors. Such devices as electric irons, electric toasters, chafing dishes and percolators, electric warming pads, electrically operated vacuum cleaners and washing machines and electric motors for sewing machines, make life infinitely easier for the modern housewife. For beautifying the home, there are Sunbeam Mazda Lamps and Mazdaliers and portable lamps; for saving stairs, there are inter-phones, and for keeping the house cool, fans.

NEWS NOTES

INCORPORATIONS.

SAN DIEGO, CAL.—Articles of incorporation have been filed of the Monarch Meter Company. The company proposes to manufacture gas appurtenances and accessories. It is capitalized at $50,000. Of this sum $26,000 has been subscribed.

LORDSBURGH, N. M.—Articles of incorporation have been filed for the Lordsburg Water, Ice and Electric Company. Principal place of business shall be in or near Lordsburg. Capital stock $50,000. The incorporators are: R. E. Cameron, M. M. Crocker, W. H. Small

SAN BERNARDINO, CAL.—For the purpose of creating a bonded indebtedness of $750,000, the Fontana Water Company has filed articles of incorporation. The bond issue is created to carry on further development of the tract owned by the company in the Rialto district.

LAS VEGAS, N. M.—The Mica Corporation, a company that expects to do a general telephone, telegraph, water rights, lighting and real estate business, with offices at Tres Piedras, Rio Arriba County, has been incorporated with a capital of $3000, by E. C. Osborn of Tres Piedras, A. L. Osborn and M. A. Calhoun of Denver.

SALEM, ORE.—Articles of incorporation have been filed by the Donald Water Company, of which A. E. Aufrance, A. Aufrance, and B. S. Quinn are the incorporators. The location is at Donald, on the Oregon Electric. The purpose is to lay and construct water pipes for serving water to consumers and to buy, subdivide and colonize lands.

TRANSMISSION.

CENTRALIA, WASH.—Excavating for the new electric light plant at Tono, an appropriation for which was recently made by the Washington Union Coal Company, has been started.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company has awarded the contract for the construction of the substation of the company's electric light system to J. C. Lasker, of Lewiston. The improvement will represent an expenditure of $20,000.

SPOKANE, WASH.—The International Power & Manufacturing Company plans to begin construction work this summer on a plant on the Pend Oreille River, in the northeastern part of Washington, designed to develop 100,000 horsepower, according to Wilbur S. Yearsley of Spokane, who, with M. H. Gerry of Helena, Mont., represents the concern.

SAN FRANCISCO, CAL.—The Indian Valley Light & Power Company, operating principally in Seneca, Greenville, Crescent Mills, Taylorsvile and Keddie, has applied to the railroad commission for authorization to issue $145,000 of new stock, of which $125,000 will be common, and $20,000 preferred. The revenue thus derived will be used to enlarge the company's facilities on the north fork of the Feather River.

VISALIA, CAL.—The Mt. Whitney Power Company has begun the construction of a new substation at Lindsay, which, when completed, will cost the company $50,000. Although the present substation has a capacity of 3000 horsepower, and was constructed a few years ago with the prospect of a great demand for "juice" in view, it has been found inadequate to supply the demand for power in the community. With a capacity of 10,000 horsepower, the new substation will be the main switching plant of the Mt. Whitney system. Work on the new structure will be rushed, and the entire building will be completed within a few months.

AMERICAN FALLS, IDAHO.—A contract has been let to Jas. A. Green Company for the construction of a power plant here for James A. Brady and associates in the American Falls Power Company. Only one unit of 5000 h.p. will be erected now, but the plant is designed to furnish 35,000 h.p. ultimately. Green's contract price is $250,000. Power and light will be furnished Pocatello and other points in southwestern Idaho.

LOS ANGELES, CAL.—At a joint conference between the Public Utilities Board and the Board of Public Works, to consider the subject of recommending an ordinance providing that steel poles shall be used in the downtown district for the purpose of carrying trolley and feed wires, it was decided that the existing arrangement is preferable to one that would cause the placing of more poles on the streets and the two boards will send to the council recommendations that the proposed plan be not adopted.

REDLANDS, CAL.—Application has been made to the State Railroad Commission by the Holton Power Company of Redlands to issue $300,000 of first and refunding mortgage gold bonds. The company does a light, power and ice business in the Imperial Valley, and wants the money to discharge current liabilities incurred in construction and for additions and improvements. The present authorized capital is $1,500,000, of which $1,250,000 is outstanding in common stock. First mortgage bonds to the extent of $500,000 are outstanding.

GILROY, CAL.—The State Railroad Commission has granted the Sierra & San Francisco Power Company a certificate of public convenience and necessity to exercise its franchise rights in the towns of Gilroy and Morgan Hill and the county of San Benito for the transmission of electric power lines. The grant was made, however, with the understanding that the power company could run its lines through the county and towns only for the purpose of extending them to Salinas or Monterey. The company will not be permitted to distribute or sell power in either Gilroy or Morgan Hill. Gilroy recently sold its municipal plant to a private corporation, which now serves the territory, apparently, according to the Commission, satisfactorily.

SPOKANE, WASH.—Thompson Falls Development Company, headed by J. A. Coram of Boston, and backed by New England capital, has completed plans, involving the expenditure of several million dollars, for power development at Thompson Falls, Mont., to supply electricity for irrigating plants in the Spokane valley and for manufacturing in Spokane, Wash., and a dozen cities in northern Idaho and western Montana, also the mines in the Coeur d'Alene district. The plant, which will be one of the largest in the world, is to be in operation within two years. The company has acquired all the necessary water rights on the Clarks Fork of the Columbia River. George H. Potter, engineer in charge, and a large force of men are at work on the preliminaries of the big dam, which is designed to harness the power at Thompson Falls. The company also has a right-of-way from the plant to Spokane, 90 miles.

ILLUMINATION.

SAN FERNANDO, CAL.—The Southern California Gas Company has applied for the sale of a franchise for a local gas system.

VISALIA, CAL.—The Central California Gas Company was the only bidder for a gas company franchise and the franchise was awarded. Lindsay will be the headquarters of

the new company. A pipe line will be taken to Porterville after the Lindsay plant has been completed.

HOOD RIVER, ORE.—It is reported that the Hydroelectric Light Company will soon begin its work of extending its line from Hood River to The Dalles. The distance is 24 miles.

BISHOP, CAL.—Application has been made by the Southern Sierra Power Company asking for a franchise and the privilege to construct and maintain an electric pole and power line throughout the county for a period of 50 years. A resolution was adopted that the franchise be advertised for sale and the board take final action on June 2, 1912.

BANNING, CAL.—Announcement of a resumption of activity here has been made by the Consolidated Reservoir & Power Company of Los Angeles. This concern is capitalized at $1,000,000 for the purpose of diverting the Whitewater River from its desert course to the better lands of the Banning Valley, where the water will be used in growing apples and in generating electricity.

ROSEVILLE, CAL.—Contracts for the electric distributing plant, incandescent lamps and for supplying the power have been awarded. The Great Western Power Company secured the contract for installing the distributing plant, the price to be $11,400. This company also secured the contract to furnish the power for lights at 1 cent per kilowatt. The contract for furnishing the 60 candle power lamps was given to the Pacific Gas & Electric Company for 83 cents a lamp. The Wagner Company secured the contract to install the transformers.

SAN FRANCISCO, CAL.—The Coast Valleys Gas & Electric Company has authorized a bond issue of $10,000,000, and issued $786,000 of them, bearing 6 per cent interest, just before the public utilities act became operative on March 23 last. Saturday the company requested that it be permitted to change a clause in the contract under which the bonds were issued. It is desired to wipe out a statement made in the contract that the company will assume all taxation on the bonds. They are tax-exempt in this State, but if sold to residents of States which do not exempt them from taxation the company would have to bear the tax burden, under the present contract. The Commission has the request under consideration.

TELEPHONE AND TELEGRAPH.

SOUTH PASADENA, CAL.—The Home Telephone Company proposes to establish an exchange in South Pasadena. A committee will confer with the company.

SAN BERNARDINO, CAL.—The work of stringing a telephone line from Lone Pine to this city will be completed by the end of the week and telephonic communication between Inyo and San Bernardino counties will begin.

LEAVENWORTH, WASH.—Work on the telephone line to connect with the Tumwater Light & Water Company's line from the summit of Beaver Creek to the head of the Lake Wenatchee will begin within a few days. It is to be constructed by the Forestry Department and work will be in charge of Forest Supervisor Sylvester.

SAN FRANCISCO, CAL.—The Third District Court of Appeals has heard the application of the California Telephone & Light Company vs. Frank C. Jordan, Secretary of State, to compel the Secretary of State to file its amended articles of incorporation. Jordan refused to file the amended articles on the ground that the law was not complied with in that the articles, as amended, did not contain the copies of the notary's certificate. The case was submitted on briefs and will be decided later by the Court.

LOS ANGELES, CAL.—Thomas Foulkes, president of the Board of Public Utilities has proposed that the position of telephone tester be created for the purpose of having a city official to investigate the many complaints of telephone service. He proposes that when a complaint is made against telephone service, the complainant must deposit $1. If the test proves that the phone is in error, the company must pay that amount, but, if the complaint is unjustly made, the complainant must forfeit the money deposited. By this means, Foulkes believes many unjust complaints will be eliminated and just ones will be rectified.

TRANSPORTATION.

OAKLAND, CAL.—A franchise has been granted to the San Francisco-Oakland Terminal Railway for an extension of its line north on Euclid avenue, Berkeley.

JUNCTION CITY, ORE.—Work is being rushed on the most difficult stretch of construction of the Oregon Electric Railway, between Junction City and Harrisburg, where the road will cross the Willamette River.

MILWAUKIE, ORE.—The City Council granted the Southern Pacific Railway Company the right to construct an electric line, telephone and telegraph lines through Milwaukie along the route of the present track.

SAN DIEGO, CAL.—The San Diego Electric Railroad Company plans to expend $100,000 for heavier weight rails to be put down in down town streets, on Fifth from Ash to the bay, University avenue and the rest on Fifth street.

SAN JOSE, CAL.—The San Jose Terminal Railway Company, by its vice-president, John A. Mehlin, has filed a petition for a franchise to construct and operate a standard gauge single or double track railroad within the city.

VALLEJO, CAL.—The Vallejo & Northern Railroad has started reclaiming 23 acres of land north of this city, which will be used for warehouses and shops. The tracks for the Vallejo & Northern are to be laid along the water front to Main street, where its terminal and depot will be. Hard Bros. are the contractors.

SAN FRANCISCO, CAL.—California is to become a bondholder in the municipally owned Geary street electric line. This announcement was made in a communication sent to Mayor James Rolph Jr. by the State Board of Control, informing the Mayor that the State is ready to subscribe for any amount of the new road bonds up to $100,000 that remain untaken.

SEATTLE, WASH.—The Seattle, Renton & Southern Railway, an electric interurban line, has been adjudged bankrupt by United States District Judge Cornelius H. Hanford, and E. M. Mills and O. D. Collins have been appointed receivers. The receivership was allowed on a complaint made by members of Peabody, Houghtelling & Company, of Chicago, a leading creditor.

SACRAMENTO, CAL.—By July 1, the Sacramento-Woodland Electric Railroad will be completed and the Northern Electric will be operating trains over the route. The Northern Electric has an agreement with the Sacramento-Woodland to operate the line until the Vallejo Northern is in a position to take it over as a part of the completed system west of Sacramento. The Sacramento-Woodland's tracks connect with those of the Northern Electric at the capital city.

SACRAMENTO, CAL.—Electric railways operating within the State and whose officers have labored under the belief that it is necessary to obtain a certificate of public convenience and necessity before proceeding with any interurban

extensions are absolved from any applications, according to an informal decision rendered by the State Railroad Commission. The Sacramento Valley Electric Railroad, proposing the construction of a line from Red Bluff in Tehama County, to Dixon, in Solano County, filed an application for a permit to begin work with the Commission, but the application was returned as unnecessary. The Commission holds that under the utility law it has jurisdiction in this respect only over street railways and not interurban roads.

SAN FRANCISCO, CAL.—Bids for supplying the city with electric power for the Geary street road have been opened, the lowest being that of the Pacific Gas & Electric Company at 1c per kw. hour for direct current and .0085 for alternating current. The board took the bids under advisement. Should the Supervisors decide that it is cheaper to buy power for the municipal road than it is to build powerhouses and generate its own electricity, the contract to the lowest responsible bidder probably will be awarded. The other bids received were as follows: Sierra-San Francisco Power Company: Direct current .014, alternating .009; Great Western Power Company .021 and .011. The United Railroads proposed some time ago to supply the city with power for the Geary street road, but from the bids received the Sierra company, which supplies the United Railroads, has been outbid by the Pacific Gas & Electric Company.

WATERWORKS.

TUCSON, ARIZ.—The Pinal Mutual Irrigation Company will commence a canal about June 1st.

LOS ANGELES, CAL.—The California-Michigan Land & Water Company has been granted a franchise for a water system in a portion of Los Angeles County.

WAPATO, WASH.—The Council has accepted the bid of the Payne Construction Company of Tacoma for $8290 for the construction of the distributing system of a water works plant.

REDLANDS, CAL.—A special election will be held May 28th to vote on the question of issuing bonds in the sum of $600,000 for the acquisition and construction by said city of a complete waterworks system. The said bonds will bear 5 per cent interest, payable semi-annually.

LOS ANGELES, CAL.—The City Council has instructed the public service commission to enter negotiations with the San Pedro Water Company with a view to purchasing the plant of that company, and serving San Pedro and Wilmington with an adequate supply of domestic water.

SALEM, ORE.—A. Eugene Aufrance, A. Aufrance and B. S. Quinn have been granted the right to lay down water pipes and mains in the town of Donald, 23 miles north of Salem. The company will begin as soon as practicable to construct a water system for that progressive city.

OAKLAND, CAL.—The City Council has awarded to William Heafey, on his bid of $11,465.35, the contract for the extension of the high-pressure salt-water system from Washington to Market street on 14th street. There were three bids received. The work will commence within 30 days.

COVINA, CAL.—The city is preparing to take over the local domestic water plant, and engineers are now figuring on the physical valuation of Covina Domestic Water Company. At a special meeting the trustees started the first action to determine what reservoirs, pipe lines and other properties of the company are worth.

SPOKANE, WASH.—One of the largest power plants in the world will be built at Thompson Falls, Mont., to supply electrical current for the irrigation of the Spokane Valley and for the development of manufacturing in the city of Spokane. J. A. Coran, the Boston capitalist, and his associates are back of the project.

SAN FRANCISCO, CAL.—California leads all other districts in the amount of water power developed under permit from the Government, according to a report received at the forest service of this city. Of the aggregate 1,383,066 horsepower, which is comprised in 165 plants, 62 plants, developing 1,026,436 horsepower, are located in California.

LOS ANGELES, CAL.—Frank G. Henderson, president of the water board, proposes the presentation of a report to the City Council outlining a complete system of water distribution; an equitable system of paying for service. Completion of the system, costing $5,000,000 or $6,000,000 by January 1, in preparation for the completion of the aqueduct.

PASCO, WASH.—The City Council rejected all bids received for the installation of the irrigation system in the two local improvement districts, on the grounds that the specifications had not been complied with. Bids will be readvertised and called for May 28th. Jordan & Wright of Ellensburg were the lowest bidders, their figures being $30,740,80 for district 43 and $18,270.85 for district 44.

SAN FRANCISCO, CAL.—Plans are completed and specifications are being written for the construction of a brick addition to the pumping station at the Presidio. Separate bids will be taken on the general construction, lighting fixtures and plumbing. The exterior of the building will be faced with repressed red brick, the roof will be of slate. Plans will be ready for figures within a week or ten days for a water-distributing system and public latrines in the National Cemetery at the Presidio of San Francisco. The water system will include 700 feet of from 1½ to 3-inch galvanized iron, some 4-inch cast iron pipes and garden hose cocks.

PORTLAND, ORE.—R. B. Metcalf, of 955 Patton avenue, who, it is understood, represents a group of Eastern capitalists, has filed application with the State Land Office of Washington, at Olympia, for the right to overflow with water, permanently, public lands for 95 miles bordering on the Cowlitz and Kalama rivers. The petition sets forth that the applicant expects to install a huge water plant. It is understood that hydro-electric engineers who have investigated the situation have reported that there is opportunity for the harnessing of more water power on the property involved in this application than has been or ever could be developed on the entire length of the Clackamas River which now furnishes Portland with all its industrial and commercial electrical energy.

OAKLAND, CAL.—The water rates committee of the Supervisors has heard arguments from the representatives of the Spring Valley Company, with the intention to show that the present rates are too low to permit the company to retain an adequate return on their expenditure. That the company hoped to increase the amount of water delivered by them to 50,000,000 gallons a day in another year, and that it would be willing to take a contract to deliver 125,000,000 a day in four years, was the statement of W. B. Bourn, president of the corporation. Bourn declared that the company proposed to protect the water supply of every one of its consumers, and that with a reasonable rate it could undertake to supply from the outside all the water desired. Chairman Andrew Gallagher of the committee said that the refusals of the company to supply water were not in accord with good public spirit, and that the conduct of employes of the company in cutting house connections and pressing the payment of bills unreasonably were largely responsible for the bitter feeling against the company. Bourn said that to give the consumer the benefit of the doubt in a disagreement over a bill was a standing rule of the company. Bourn urged an allowance for depreciation, and asked for an appraisal of the company's property, stating that no such estimate had been made since 1901.

Snoqualmie Falls.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII — SAN FRANCISCO, JUNE 1, 1912 — NUMBER 22

PUGET SOUND TRACTION, LIGHT & POWER COMPANY'S SYSTEM

By Rudolph W. Van Norden
Member A. I. E. E., A. S. C. E.

Mt. Rainier From Electron Flume.

Map of Territory Served

A HISTORY of the development and use of electricity in the northwest corner of the United States and particularly adjacent to one of the world's most remarkable inland harbors, Puget Sound, would be but a repetition of the commercial history of electricity, and yet, no section of the country is richer in individual characteristics and conditions which place the development and use of electric power amid more picturesque or unique surroundings.

To the visitor familiar with the methods and customs in other sections of the country, there is a constant source of interest and wonderment, divided between the accomplishment here and the ever-changing, but never-ending variety of scenic beauty and topographical advantage which nature has provided as a fit setting. Nowhere would it be possible to see the art of power development better exemplified as a logical result of natural surroundings, and nowhere can be seen to better advantage the upbuilding of a comparatively new country, into a great metropolitan district, as the result of the introduction and aid of electricity.

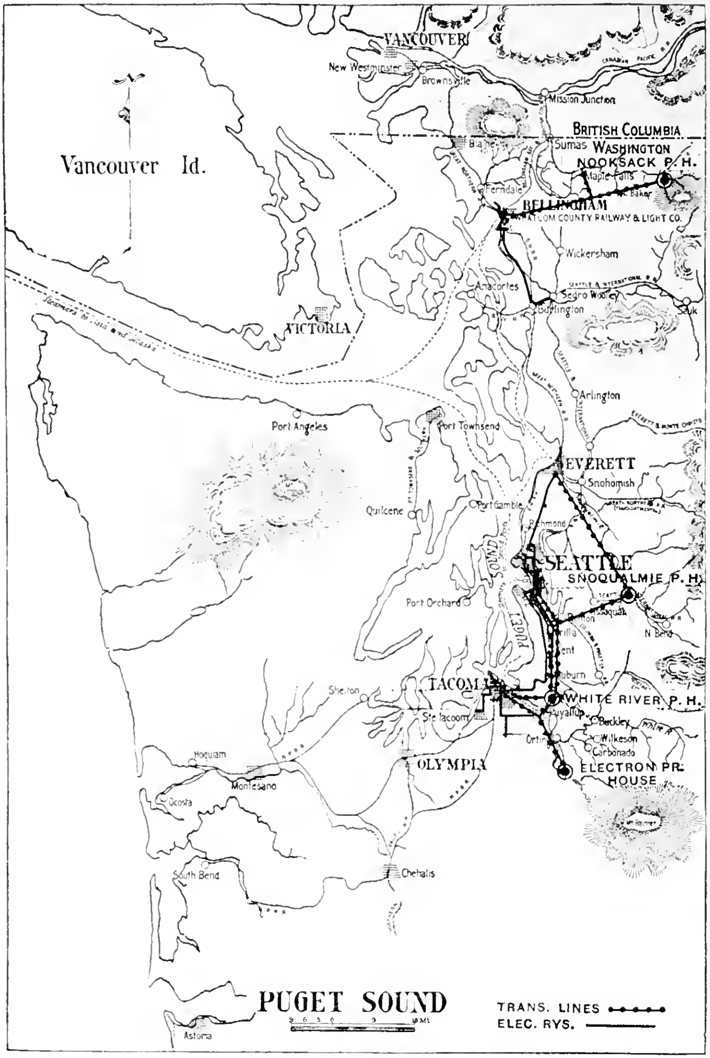
By far the greater part of the population of Western Washington is on the eastern and southern shores of Puget Sound and it is this district in which are the principal tide water cities which are served by the great electrical distribution network about to be described.

As in other centers of population the growth here of this system has been the welding together of many

smaller enterprises, each reaching out as the art advanced and as its sphere of usefulness increased, until the gaps were covered and a logical unit has been created in the Puget Sound Traction, Light and Power Company.

Far reaching results have been accomplished by the great managerial machine that the Stone & Webster operating company represents, and the unity of purpose between this, the Engineering Corporation, and the various constituent parts is shown by the very evident care exhibited in the selection of a high class of men, whose interests are clearly those dictated by a broad and generous public policy; the best grade of equipment and service, and the apparent desire to maintain the finest standards.

The symbol of the triangle and triskelion, which may be seen on all the company's equipment, advertising and correspondence, is the emblem which has been adopted to exemplify these high aims. For the equilateral triangle stands for stability and can never rest on any but a stable foundation. This, then, represents the thorough organization of all parts and solid structures, both physically and commercially. The triskelion is an emblem of great antiquity and represents motion: the gathering and holding together of individual motions to co-ordinate and respond in unison about a common center. This symbolizes unceasing activity and continual advancement as a prime principle in a world development.



Map of Puget Sound Traction, Light & Power Company's Lines.

Market for Power.

The territory served by the Puget Sound Traction, Light and Power Company is one of enormous natural resources. The manufacture of cement on a large scale represents an important industry. Coal deposits are distributed throughout the district and the outlet is here provided for the products of a vast interior agricultural and fruit country. Its cities are the logical ports for the output from the Alaskan territory, and steamship lines to the Orient form the connecting link with the four transcontinental railways which terminate on Puget Sound.

The market for power is varied and covers the supply of electricity to many large industries. At all points large amounts of power are supplied for railway operation. This being a lumbering country, power is supplied to mills of all descriptions. At Everett the Great Northern Railway shops require 575 h.p. and at Seattle, Tacoma and Auburn, power is also supplied for a like purpose. At Seattle are large flouring mills and all other industries incident to a metropolitan city. At Tacoma a block of 3,000 h.p. is supplied to a smelter.

Practically all of the 2300-volt distributing lines are two-phase and all of the lighting is done from these circuits, except in the downtown commercial district in Seattle, where a low voltage, Edison three-wire direct current system is in extensive use.

HYDRAULIC POWER PLANTS.

Snoqualmie P. H. No. 2.

THE Nooksack Falls plant is situated on the Nooksack River, where a fall of 165 ft. is obtained. A timber crib diverting dam delivers the flow into a concrete intake in which are gates. After passing through a tunnel 300 ft. long, having a section 5 ft. x 5 ft., excavated through rock and timber lined, the water passes through sluice gates into a timber forebay. There are two pipe lines; one is of riveted sheet steel 47 in. diameter and 1300 ft. long; the other is a wood stave pipe having a diameter of 44 in. The pipes approach each other on a curve and join in a steel "Y" manifold fitting and from this receiver are the various outlets to the waterwheels.

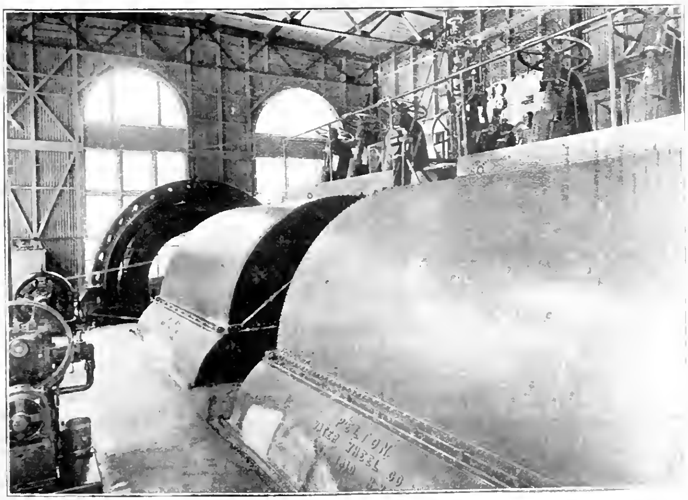
The powerhouse is a concrete structure 57½ ft. x 40½ ft., having two temporary ends for future extension. The roof is carried on Howe steel trusses.

The generator is a Westinghouse 1500 kw. revolving field, delivering three-phase, 60 cycle current at a potential of 2200 volts. It is connected through a flexible coupling to a Pelton tangential water wheel equipped with six runners. Each runner is supplied with two nozzles, the upper nozzle on each wheel being needle regulating and the lower plain, supplied with deflecting hoods. The maximum capacity of the waterwheel is 3200 h.p. and the speed of the unit 200 r.p.m.. The exciter is a Westinghouse 45 kw., 125 volt d.c. generator, belted to the generator shaft.

The switchboard is in three panels and is Westinghouse standard equipment. There are three 500 kw. Westinghouse, oil immersed, air cooled raising transformers, the primaries wound for 2200 volts delta and the secondaries for 28,000 volts star. These transformers will be soon replaced by transformers to deliver 55,000 volts.

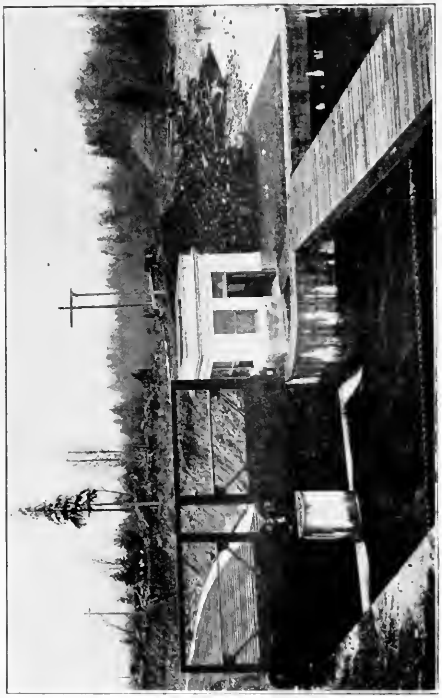
White River Plant is the newest and the largest of the power plants on this system and when the complete installation shall be completed will be the largest plant in the Northwest. The development of the natural fall of the White River combined with the storage possibility of Lake Tapps has been in prospect for a number of years, but it was not until 1910 that this company started active development work. This installation is one of those which are a joy and inspiration to the engineer as it would seem that nature itself had purposely created the conditions with the eventual development of a large power plant in view. Almost everything is here provided for the working out of designs, both economical and safe. The White River flows in a north-westerly direction

Intake for Nooksack Power House.

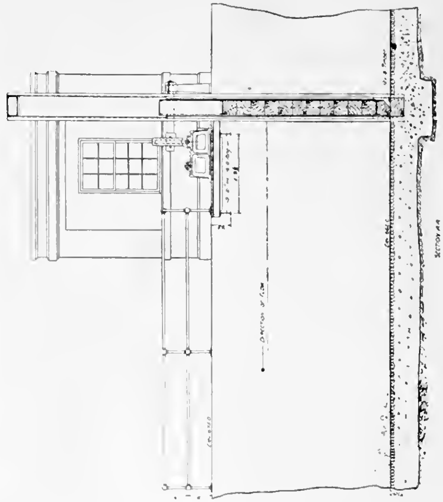


Interior Nooksack Power House.

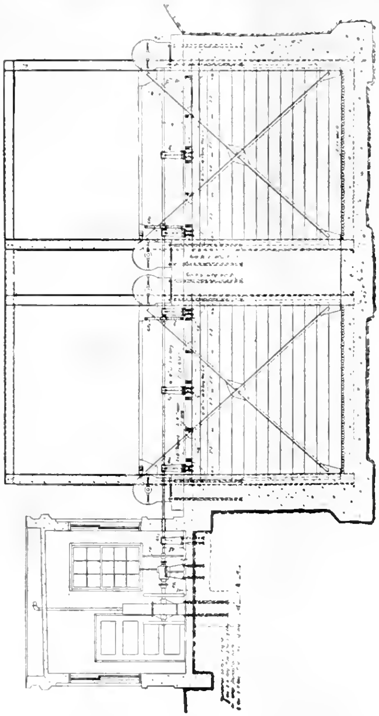
Nooksack Power House.



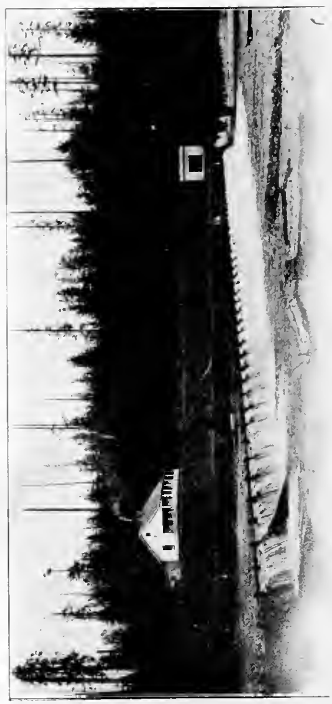
Gates and Operating House.



Longitudinal Cross Section.

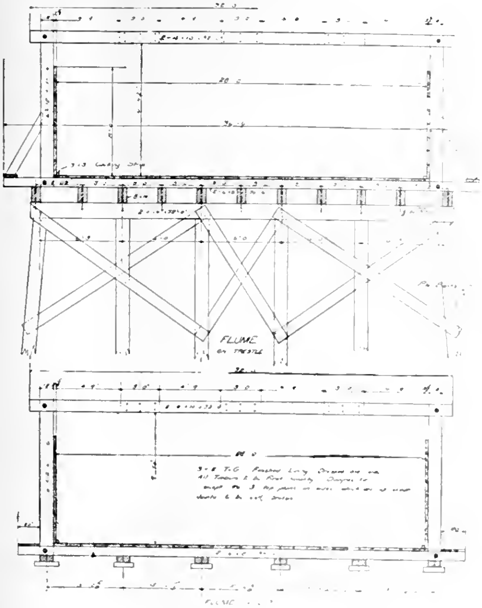


Transverse Cross Section.



Dam.

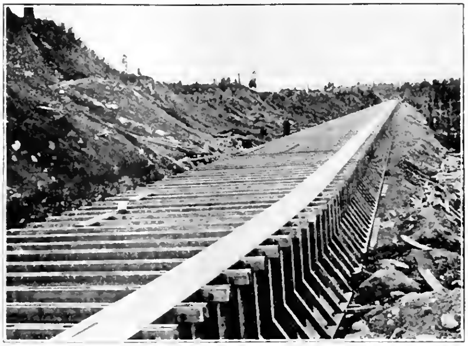
Intake of White River System.



Typical Flume Sections.

through the foothills of the Cascade range until the valley is reached, where it joins the Dahomish and is discharged into Puget Sound at Seattle. A large minimum flow, an extremely simple diversion, a high more or less level plateau, south of the river, terminating precipitously at the edge of the valley, a natural lake in this plateau with the possibility of greatly increasing its area and volume, a safe grade for the pipe lines and finally a powerhouse location on the main county highway, on three transcontinental railroads and between the two principal seaport cities of the state in a district where the older power lines were brought to get their market. Full justice has, however, been done in developing this wonderful site, for it would be difficult to find a system and plant of more economical or logical and yet simple design, showing throughout the careful thought in the design of details and the thorough understanding of all the conditions, local and general to be encountered. The construction work and finish is in keeping with the merit of design and the system is well worth the study of the engineer and operator.

Engineering interest commences at the intake dam, which is quite out of the ordinary for a river of this kind. The river, at the point of diversion, is fairly straight with a flat bed of the native cemented gravel. In order to give the necessary depth for the diversion a low dam only was required. Ordinary high water can be readily handled, but an ingenious method was necessary to prevent damage from flood. A trench was cut across the river and in this cut a slab of concrete was placed. Upon this foundation a timber crib dam was erected to a height of three feet. The top of the dam was finished with a flat crest, both the up-stream and down-stream faces being sloped, the former about two horizontal to one vertical, while the latter face was built one to one. The crest has an elevation two feet above the intake sill. Near the down-stream edge of the crest is a row of cast iron socket footings securely fastened flush with and to



Flume on White River Canal System.

the crib work, which is in turn bolted to the concrete foundation. In these sockets are fitted vertical timber posts 4 ft. high made of two 3 in. x 8 in. timbers bolted together. Near the upper end of the posts is an eye-bolt and hooked into the eye-bolt and extending toward the up-stream face, in an inclined position, is a 5/8 in. iron rod, the lower end of which is hooked into a bolt fastened into the crest of the dam. Flash boards are placed against the up-stream side of the posts. The strain rods are carefully calibrated for strength, they being intended to break and thus let the posts and flashboards wash away when the pressure against them, due to a certain height of water flowing over them, is reached. This high water point does not occur often and if the dam is broken, thus relieving all strain, the loss is so small as to be negligible. The crib section is covered with 3 in. planks on the up-stream side.

The intake diverts at right angles from the river. The weir crest is of concrete and the side walls of the same material. The intake bay curves around until the direction of flow is nearly parallel with the

Flume in Earth Canal.

river. The 12 ft. x 12 ft. timber gates, separated by a concrete pier, control the entrance into the canal, the sides of the gates being lined with stone. The gates slide in 12 in. steel channels and are operated by an

Lake Tapps.

enclosed worm-gear at each end. These in turn are driven by pinions on a common shaft, each pair of pinions sliding out of gear when it is desired to move one gate and not the other. The operating shaft extends into a 12 ft. x 12 ft., reinforced concrete gate house having a concrete roof. Within the gate house is a Fairbanks-Morse 9 h.p. vertical single cylinder gasoline engine which operates the gates.

Beyond the gates the canal is paved with hard glacial boulders laid in cement to prevent scouring. This seems to be the solution of a difficult problem at this point as there is often sharp sand and cobbles which are carried by the water, the latter coming from glaciers on the side of Mt. Rainier.

The canal is now carried through an undulating country, passing through several artificial and natural basins and waterways and discharging into Lake Tapps. Beginning at the intake there is a flume for one mile. The ground surface for this flume was prepared in alignment and level as for a railroad except that it is wider. The flume has a clear width inside of 28 ft. and is boarded on the sides 8 ft. high, the depth of flow being 7 ft. There are two 4 in. x 12 in. stringers blocked together and spaced every four feet. The uprights are 6 in. x 12 in. timbers and the sills of the same size as the stringers. Longitudinal stringers are placed under the sills and these are supported on three rows of piles driven flush to the ground surface. The flow capacity of this flume is 2000 second feet.

Following the flume is a section of earth canal into which the water passes after traversing an artificial settling basin. This canal is two miles long. Steam shovels were used in its construction, there being two Marion No. 60, 1½ yd., one Marion No. 20, 1 yd. two Vulcan 1½ yd., and one Marion No. 35, ¾ yd. shovels. There is then a section of earth canal which is lined with a flume which is purposely not watertight. There are three rows of piles, two at the sides of the flume and extending to its top and to these are fastened the sideboards. The third row is down the middle and on them is a line of stringers on which the sills are supported. A sharp change in grade is shown in the view of this flume. The flow now enters an artificial basin of about 12 acres and then follows a natural waterway for two miles, discharging into Church Lake, a natural body of water two miles long and a half mile wide. From here it empties into an earth canal and natural channel 1500 ft. long which carries the water into Lake Tapps.

Lake Tapps is an irregular natural body of water surrounded by forests. In order to increase its capacity it was necessary to close many gulches or ravines through which the lake would have an outlet if

Earth Canal on White River System.

A Dam in Lake Tapps.

the original surface were raised. The closing of these ravines has been accomplished by the extensive series of earthen dams which have been erected, this line of dams extending at intervals along the north side of the hydraulic system, forming the different settling basins along the line of canal. These dams are formed of the natural gravel soil and are of various heights and lengths. Excavation work at the spoil pits was done with steam shovels loading onto cars. Track was laid on trestles at the dam sites from which the material was dumped to form the dams.

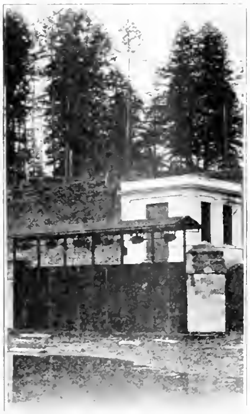
Near the lower end of the lake a complete electrically driven sawmill was erected with a capacity of 90,000 bd. ft. per day, to supply the timber necessary for the work.

The power plant intake was necessarily placed some distance from the lake, due to the ground contour and a connection between these points was made by dredging a canal, 50 ft. wide at the bottom and 1800 ft. long. This excavation required the removal of 600,000 cubic yards of material. It is lined with a submerged timber flume.

Tunnel from Intake Chamber.

The slope down which the pressure pipes are laid has an anticline toward the lake and against this the intake is placed. This is of concrete with a pair of circular wing walls, forming a semi-circular entrance to the gates. Across the front ends of the wing walls is a series of 6 vertical steel-bar screens and placed in front of the screens are rakes which may be hoisted by ½ in. steel wire ropes. Above the screens, protected by a canopy, is a countershaft on which are mounted drums equipped with friction clutches and on these drums the hoisting ropes are wound to raise the rake. The countershaft is operated by a 10 h.p. General Electric induction motor. Water, after passing the screens, goes through a 12 ft. x 12 ft. sluice gate, similar to the intake gates into a tunnel. This gate is raised and lowered by two stems which are operated by a 25 h.p. variable speed induction motor and near which is a switchboard control panel. There is also a 24 in. hand-operated by-pass gate. The gate mechanism is enclosed in a reinforced concrete house 18 ft. x 18 ft. x 18 ft. high.

The tunnel is circular in section, 12 ft. in diameter. It is lined with concrete heavily reinforced with twisted bars and old railroad iron. The length is 2850 ft., and the grade 4 ft. per 1000 ft. Midway of its length is a 12 ft. circular vent and at the ground surface is covered with a square concrete structure, 5 ft. high, the sides of which are open but screened. A waste way is carried from this vent to take any water that may slop over. The tunnel ends in a concrete basin which is integral with the gate house and pressure pipe intake. Before passing through the pipe gates, the water again passes through vertical bar screens into the intake chamber. The rear wall of this is arranged in a segment of a circle, the three pipe entrances being 60 degrees apart. Each pipe opening is controlled by a Coffin sluice gate and mounted above the gate on the floor of the gate house are the operating stands,



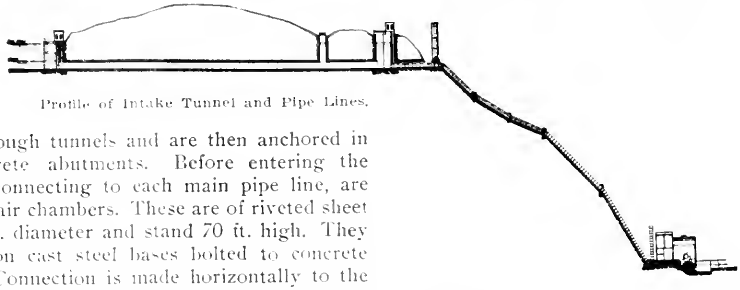
Tunnel Intake.

Tunnel Overflow.

equipped with a two-speed gearing and driven in each case by a 25 h.p. variable speed induction motor. Here is a 3-panel control board, the control being either from this point or from the switchboard in the powerhouse. A limit switch is mounted on the gate stand and the position of the gate is indicated by lamps at the power house. The gate house is a reinforced concrete building 18 ft. x 36 ft. and is provided with a 12 in. I beam over each stand for a chainblock hoist.

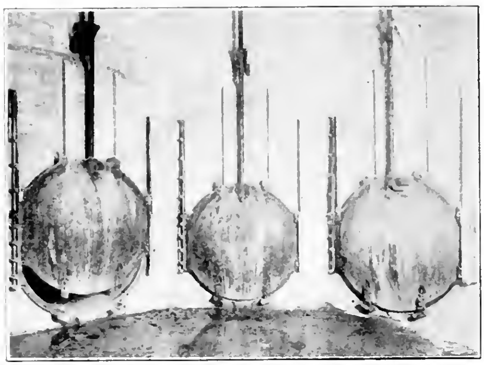
The pressure pipes after leaving this intake, pass through egg-shaped concrete lined tunnels for a distance of 200 ft. and then are laid in trenches which are backfilled, leaving the pipes buried, to the power house. There are at present installed but two pipe lines, provision at the intake being made for a third. Near the top are the two standpipes of riveted sheet steel. These are 6 ft. in diameter and 60 ft. high. Just before the standpipes are reached, a 24-in. outlet is taken from the upper side of each pipe. These are fitted with gate valves and connect to a horizontal manifold pipe of the same diameter which, continuing to one side, supplies the exciter pipe line through a gate valve.

The main pipe lines have a diameter at the top of 8 ft. and at the bottom a diamter of 6 ft. 6 in. The total length is 2141 ft. The exciter pipe is 24 in. diameter tapering to 20 in. In the final 400 ft. the pipes pass through tunnels and are then anchored in massive concrete abutments. Before entering the power house connecting to each main pipe line, are two standpipe air chambers. These are of riveted sheet steel, 6 ft. 6 in. diameter and stand 70 ft. high. They are mounted on cast steel bases bolted to concrete foundations. Connection is made horizontally to the pipe line through a 24 in. fitting in which is a gate valve. Where this fitting joins the standpipe is a valve actuated by a ball float. The valve shaft is brought outside through a gland and has a lever and counterweight. This is for the purpose of automatically closing the valve when the water within raises above a certain point. Compressed air above this water level is maintained by a large motor-driven compressor in the basement of the power house. These air chambers act as elastic cushions to compensate for the shock caused in the pipes by the sudden change in velocity of the flow, due to regulation of the waterwheels.

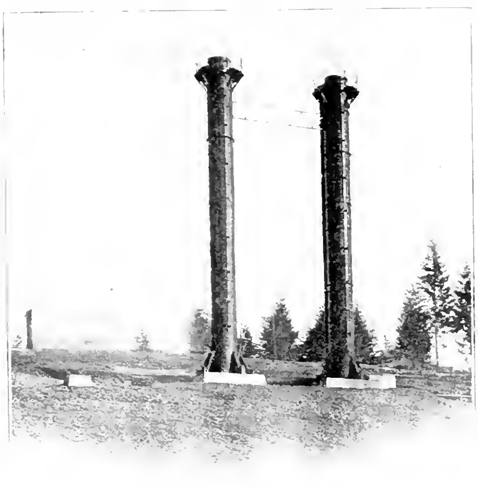


Profile of Intake Tunnel and Pipe Lines.

The building is of reinforced concrete throughout, for walls, columns and roof, the latter being supported on Howe steel trusses, and having a monitor roof along the center line. It is arranged on four general levels, basement, with four separate compartments containing auxiliaries, main floor on which are mounted generating units, transformers and generator busses, a mezzanine floor containing switchboard generator circuit-breakers, offices, lavatories, and store rooms and a high tension floor containing high tension switches and apparatus. The entire arrangement is simple and logical for effective operation. The finish, inside and out is light and plain, care being taken to give pleasing proportions in the design, the entire effect being satisfactory and not calculated to become monotonous to those who may be constantly associated with the plant. The columns divide the building into eight panels, while between the front and center row of columns is the main operating bay which extends from the main floor to the roof. The south end of the building has a temporary wall, as it is proposed to eventually make a further extension. The wall here, instead of marring the general appearance until the extension is made, as is so often the case when corrugated sheet iron is used, is made of metal lath and cement plaster, finished to correspond with the general architectural scheme, this costing very little more than the more temporary arrangement.



Penstock Gates at White River Forebay.

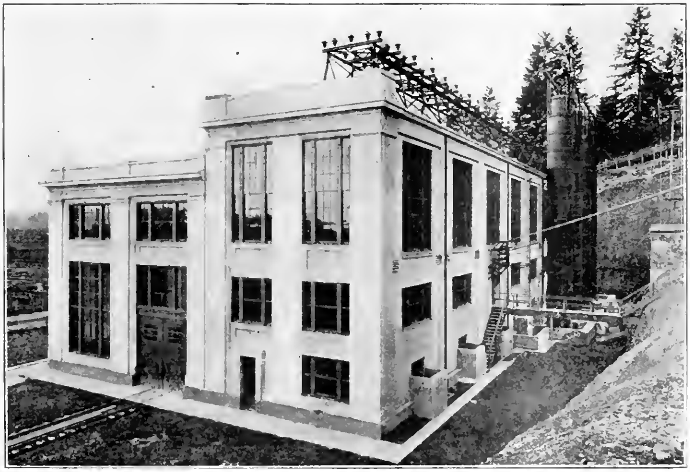


Penstock Gate House and Standpipes.

The main transformer compartments are placed back of the middle line of columns and extend vertically between the main floor and the high tension floor. These cells occupy the first three panel spaces. The exciters are placed under the switchboard mezzanine on the main floor level and occupy the next three transverse panels. The seventh and eighth panels have cells similar to those for the transformers, the former, however extending vertically only to the mezzanine floor. In this space are two sets of transformers for plant lighting and one set of power transformers for local distribution. The last space is at present vacant.

The four basement compartments are each reached by a flight of iron stairs from the main floor

level. The most northerly compartment is an oil room housing two steel tanks, 5 ft. 6 in. diameter by 13 ft. long, for containing No. 8 transformer oil; 2 vertical tanks 6 ft. diameter by 7 ft. high, for No. 6 bearing oil; one 12 in. oil filter of 20 chambers containing 30 sq. ft. of filtering area and having a capacity of 30 gal. per minute. Connecting this apparatus is a brass pipe rack equipped with 27 valves whereby all of the



White River Power House.

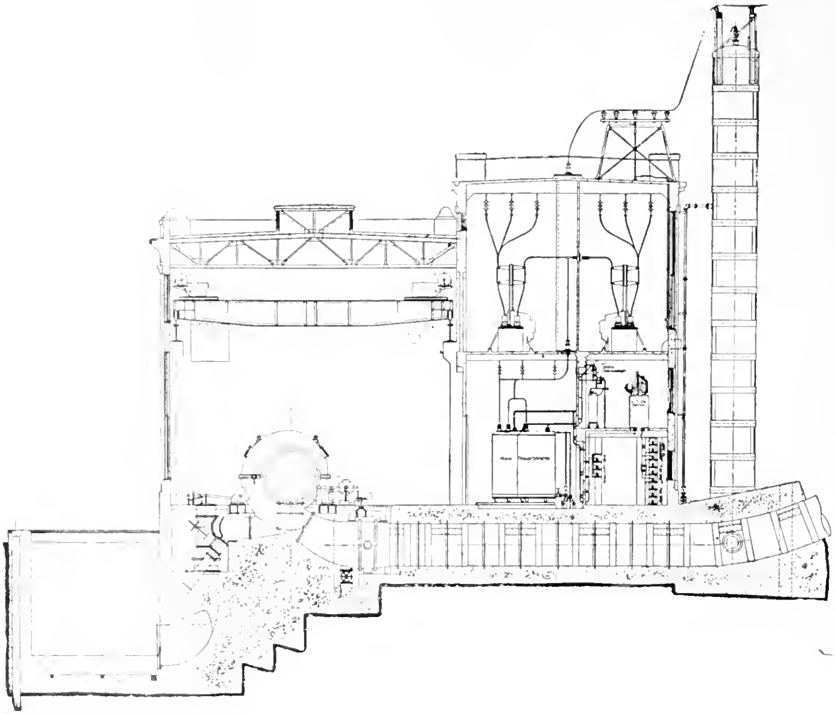
Main Generator Room of White River Power House.

various combinations may be made to circulate oil to and from the transformers for changing, filtering, filling, etc. A 7½ h.p. induction motor driving a centrifugal pump is the means of moving the oil, but connections are also provided for compressed air operation whenever necessary. In the second compartment is installed a two-cylinder Ingersoll-Rand compressor, driven by a 2200 volt, 150 h.p. form K, induction motor. Also a three-crank pump driven by a 10 h.p. Westinghouse induction motor for supplying water to the surrounding buildings, camp, etc. In the third section of the basement are placed the main generator rheostats. In the fourth section are three Allis-Chalmers, gear-oil-pumps, for supplying operating pressure to the governors, each driven by a 65 h.p., 220 volt, Allis-Chalmers induction motor. One of these oil pumps is also driven by an Allis-Chalmers 70 h.p. tangential water wheel, hand operated, which is attached through a disconnecting clutch. Each pump will deliver 90 gal. per minute against a pressure of 400 lb. per sq. in. There is also a two-cylinder oil pump for furnishing oil to the machine bearings, driven by a 5 h.p. Westinghouse induction motor.

At present two main generating units are installed; the generators are General Electric type, A. T. B. form S, having a normal load capacity of 10,000 kw. The armatures are star-connected and deliver three-phase current at 6600 volts. The water wheel is

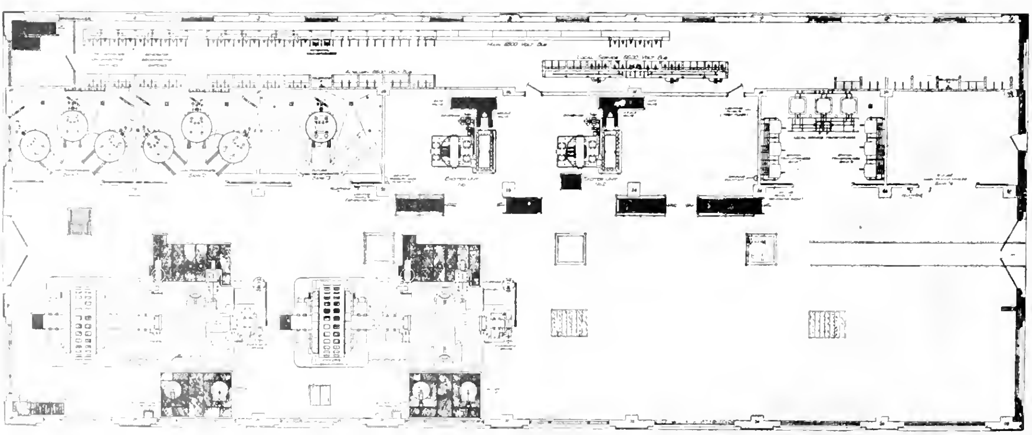
a Francis double flow turbine with scroll case. The unit has four bearings and operates at 360 r.p.m. A butterfly valve is introduced in the pressure pipe immediately before reaching the turbine and this is operated by a d.c. motor. On the floor back of the set is a panel switchboard for this motor with solenoid operated rheostat, switches, etc., and the control may be had at this point, at the motor or at the main switchboard. Allis-Chalmers governors operating with oil at a pressure of 300 lb., are mounted close to the turbine.

There are two d.c. exciters; the generator is General Electric, type M. D. C. form L, six poles with interpoles, 240 volts with a capacity of 225 kw. The waterwheel is Allis-Chalmers, having an overhanging runner mounted in a cast iron housing and equipped with a needle regulating nozzle operated by an Allis-Chalmers type O governor. It has a capcity of 500 h.p. and operates at 400 r.p.m.



Transverse Section Through Power House.

The main transformers are single-phase, there being three in a cell which is open to the main bay, this opening being however smaller than the cell, 11 ft. wide by 15 ft. high. The floor of the cell is de-



Plan of Main Operating Floor.

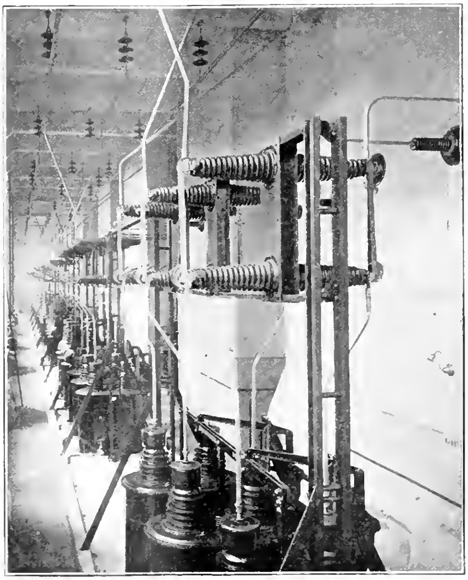
pressed 8 in. below the main floor and laid to drain to two points. The transformers are rated at 3333 kw. each and are wound for 6600 volts primary to 55,000 volts secondary, both sides being delta connected. They are General Electric type E. I. They are mounted on steel trucks with 6 in. cast iron wheels which in turn rest on a 3 ft. 6 in. track of 60 lb. rails. The tracks are laid, the center one being normal to the entrance, while the two others are placed at an angle so that in moving out, the transformers come out at the center of the entrance. The high tension terminals are wound fibre tubes with round fibre barriers.

The delta connections are made directly above the transformers and the high tension leads are supported from the ceiling of the cell on 8 sets of small three-part suspension insulators. The cell openings may be closed by double sliding doors of wood covered with tin plate and weighted open with cord and pulley.

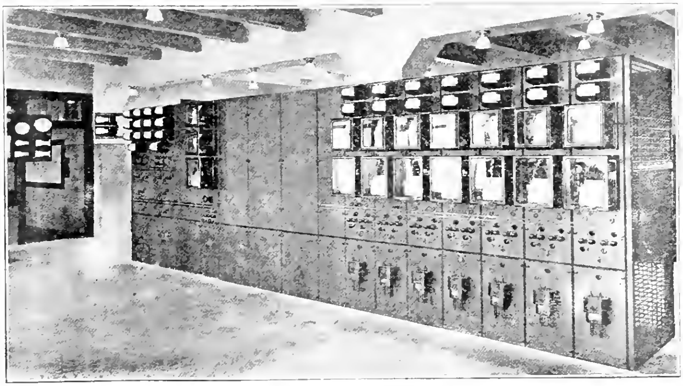
In the rear of the transformers, mounted on the main floor level, are the disconnectors, double bus and meter transformers, all mounted in concrete cells, for the 6600 volt circuits. All circuit breakers are motor operated by remote control. The 6600 volt generator circuit breakers are type K-4 and mounted in concrete cells and are placed on the mezzanine floor in the rear of the transformers. Two sets of K-4 bus junction switches are mounted in the rear of the main switchboard. Near this set is a motor-generator battery charging set consisting of a three-phase, 220 volt motor, driving a 5 kw. d.c. generator. A Gould storage battery delivering current at 110 volts for operating the circuit-breaker motors and also a few emergency lights is installed in an adjoining room.

The upper floor is divided longitudinally by two parallel walls which are spaced 4 ft. apart. Over each longitudinal compartment extends a 55,000 volt bus line. In the forward compartment are 8 sets (3 single pole each) of K-15 oil circuit breakers connecting to eight transmission lines, and 2 sets of K-10 circuit breakers on the transformer leads. In the rear compartment are 7 sets of K-15 circuit breakers, with space for one more, to the transmission lines, and two K-10 circuit breakers to the transformers. One side of all of these circuit breakers connects to the bus over it. Disconnecting switches are provided on both sides of all oil switches.

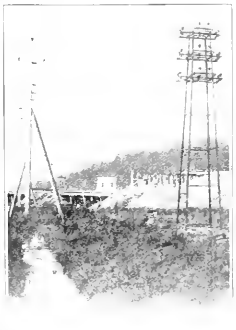
The transformer leads, and outgoing lines are carried up between the longitudinal walls. The outgoing lines pass through the roof of the building in roof insulators. A steel rack running the length of the building carries the line insulators for all of the transmission lines and Pacific Electric disconnecting switches on each line. These pass directly to the lightning arrester structures which are placed in the rear of the power house, a short distance up the hill. There are 8 lightning arrester houses; these are of concrete, 8 ft. x 16 ft. x 18 ft. high and contain aluminum cell arresters and a discharge recording device. The horn gaps are mounted on the roofs of these buildings.



Switches and Busses.

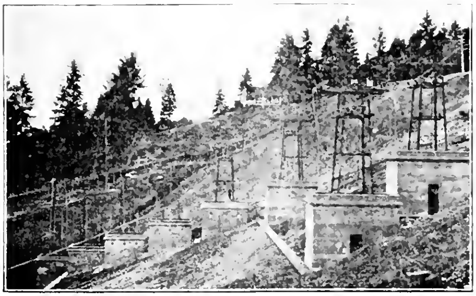


Main Switchboard at White River Power House.



Typical Steel and Wood Tower Transmission Line Construction.

All high tension wiring in the building and on the lightning arrester structures consists of 1 in. galvanized iron pipe finished with bronze paint. This is not only a serviceable arrangement, but it is strong and rigid and low in cost.



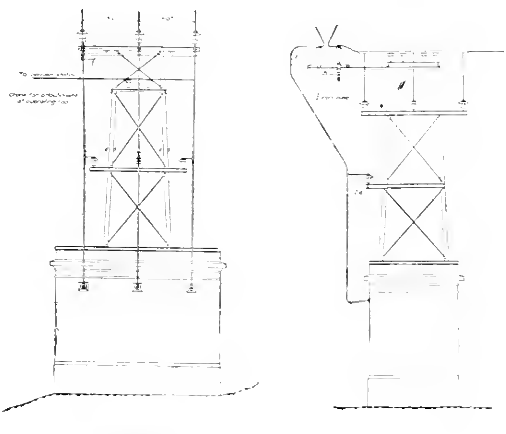
Lightning Arrester Houses and Transmission Lines.

Five telephone circuits are brought to the rear of the powerhouse, being protected by telephone transformers and fuses.

The switchboard gallery extends in an arching balcony into the main bay and is enclosed with windows; it occupies a space 40 ft. x 50 ft. The switchboard is of black slate in three parts. The main board, which controls the main units and lines, sets back from the balcony about 18 ft. and is parallel to it. The other sections are at right angles and are set across either end.

The north end board has three panels and two swinging arms, two controlling the exciters, the third containing a T. A. voltage regulator, while the arms carry instruments, a clock and a synchronizer.

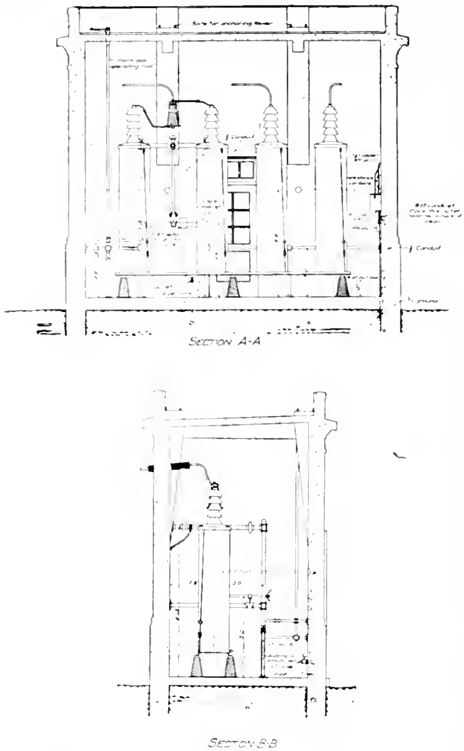
The main switchboard has fifteen panels; two panels controlling generator and transformer remote control switches; one panel equipped with three graphic curve drawing instruments; seven panels with wiring diagram and remote control for the transmission circuits; five blank panels for future use. Time limit relays are installed on all outgoing circuits as well as integrating wattmeters.



Elevations of Lightning Arrester Houses.

The south end swithboard has five panels controlling consecutively, storage-battery, lighting, pressure gauges on governor system and on pipes and remote motor control.

Electron Power Plant derives its water supply from and is situated on the east bank of the Puyallup River. This is one of the streams which finds its source in glaciers of the western slope of Mt. Rainier. The river, which has a rapid fall, flows through a deep wooded canyon. The situation of this plant is more nearly like that of many of the high head Pacific Coast installations. For the lover of nature, its lights and shades, its coloring and wonderful perspectives with Mt. Rainier with its awesome grandeur

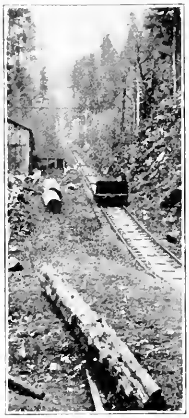


Vertical Sections Through Lightning Arrester House.

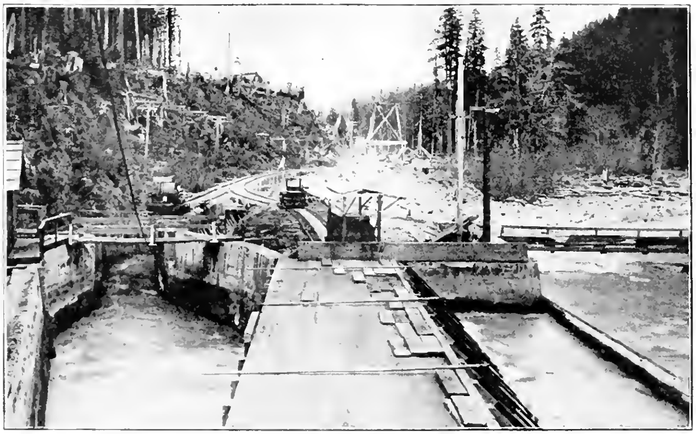
for a background, this is indeed an ideal country. But for building and maintaining a power plant the esthetic features have shown themselves to be more or less impractical, for here there is not the natural preparation of site that was found at White River.

This plant, which was completed in 1904, was famous in its time as an example of modern high head design and has given faithful service, with the exception perhaps of the necessarily high depreciation expense of a mountain-side timber flume.

The intake from the river is an even more simple affair than that of the White River plant, it being a timber crib dam 200 ft. long and 5 ft. high across the river, giving the water sufficient depth for an entrance into the canal. The intake consists of 14



Cable Tramway.



Intake of Electron Flume.

openings set in a line parallel to the flow of the river on the east side and is 62 ft. wide. These openings may be closed by planks which slide into place being held by steel rails. A masonry bay is formed by carrying the wall around against the bank, the lower wall making a right angled turn to form with it an entrance for the canal. There is no sluice gate due to the frequent entrance of glacial boulders which are allowed to enter the canal to be discharged at a specially built gate.

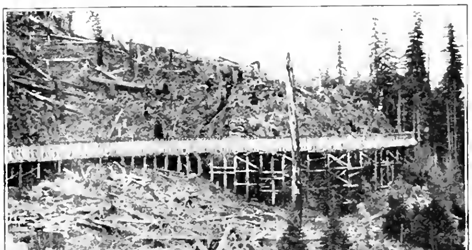
From this entrance the canal consists of timber flume and this follows the contour of the mountain side in a general way, sometimes almost on the ground, then again on high trestle, for a distance of ten miles, where it empties into a forebay reservoir.

The flume has a capacity of 360 second feet and carries 6 ft. 6 in. depth of water. The grade is 7 ft. per mile. Originally the flume was built to carry but 4 ft. of water, having five 12 in. planks for siding. Later three more planks were added and new sills and studs were placed between the original ones. The planks, or boxes, are 16 ft. long and there are 330 per mile. There are 12 spillways, near the entrance being the rock spillway with an enlarged section and a bar screen. A standard gauge 30 lb. steel track is laid on the top stringers and transportation for attendants and materials is thus accomplished by means of gasoline motor cars. Along the flume is a line of poles which carry, besides telephone wires, a three-wire, three-phase, 2200 volt, aluminum (equivalent to No. 4 copper), power circuit. Two double truck cars equipped with induction motor-driven electric hoists and one car with a steam rig are provided for rapid repair work on the flume. In operating the electric hoists, the supply wires are tapped to the power line at any point, transformers being mounted on the cars. A sawmill, electrically operated, situated near the upper end, supplies flume timber.

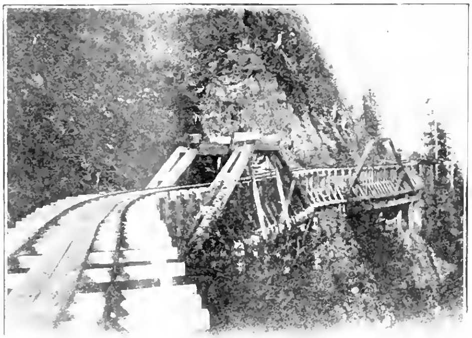
The forebay reservoir was made by throwing up earthen embankments on two sides. It covers an area of 10 acres and has a capacity of 7,000,000 gal.

The glacial silt carried by the flume, were provision not made for cleaning out at regular intervals, would soon fill the reservoir. A barge is provided on which is mounted an 8 in. sand pump having a rated capacity of 150 yd. solid matter per hour. This is belt driven by a 40 h.p. type CX, Westinghouse induction motor. Another belt from this motor also drives a 2 in. centrifugal pump for the submerged water jets. An articulated pipe mounted on pontoons discharges the silt from the pump over the reservoir bank.

The four pressure pipes, which at the top are wood stave construction, are carried through the reservoir bank to the intake heading, which is placed in the reservoir, about 100 ft. from the crest of the bank



Electron Flume.



Difficult Construction on Electron Flume.

Forebay Reservoir at Electron, Showing Suction Dredge.

The intake is of massive concrete and contains four sloping bar screens of 1-in. separation. Behind the screens are the screw stem sluice gates, hand operated with bevel gears. There is one small gate for the exciter supply pipe. A Dibble reservoir gauge is installed on the intake.

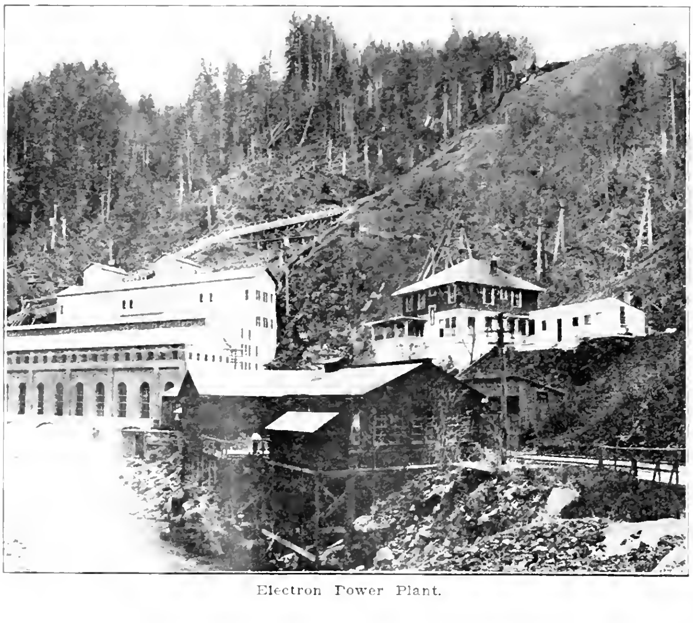
Wood stave pipes are carried through the reservoir embankment where they join with sheet steel riveted pipes, these being anchored in a concrete retaining wall. Each pipe has an open standpipe. The pipes now take direct plunge down the hillside, being anchored every few feet in heavy concrete abutments. Before entering the power house the pipes are heavily anchored in concrete blocks. The diameter of the main pipes at the top is 48 in. and the thickness ¼ in. and at the bottom 36 in. with a thickness of ¾ in. The wood stave pipes have a diameter of 48 in. The hydrostatic head on this plant is 872 ft.

The pipes are carried under the main floor of the powerhouse, each pipe dividing in a cast steel Y fitting, and each branch connecting directly to each of the two deflecting needle nozzles of each generating unit. The exciter pipe likewise divides each branch supplying the water wheel of the two exciter units.

The power house is built in two sections, of brick and concrete, the one section nearest the river containing the generating units and switchboard, and the other, built in several stories, due to the steepness of the hillside, the low and high tension switches and busses, the upper story being of timber and corrugated galvanized sheet iron.

The four main generating units are rated at 3500 kw; the armatures are Y connected and deliver 2300 volts and operate at 225 r.p.m. There are two Pelton waterwheel runners mounted in separate combination cast iron and sheet steel housings overhung at either end of the generator shaft. The single deflecting needle nozzles on each wheel are operated together by a Lombard type L governor. The nozzle needles are actuated from the switchboard by a 5 h.p. d.c. series motor. The main gate valves in each branch are operated by screw and worm gear by a 3 h.p., d.c. series motor. Oil under pressure for the governors is supplied by a Lombard triplex pump driven by a 6 h.p. series d.c. motor.

There are two 3-bearing exciter sets, having Pel-



Electron Power Plant.

Main Generating Room Electron Power House.

ton water wheel, induction motor and d.c. generator. The motor is General Electric, 200 h.p., 2080 volts, three-phase. The generator is of same make, 125 volt and rated at 150 kw. The speed is 600 r.p.m.

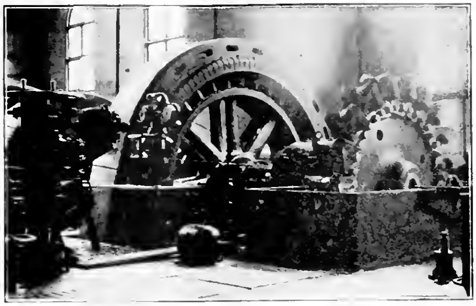
The switchboard is arranged in a semi-circle on a balcony at the far end of the building. It is of blue marble and has 17 panels, and is of a conventional type. There are four generator panels; two d.c. exciter panels; three panels on transformers with time limit relays; two transmission line panels; one T. A. voltage regulator panel; one panel with graphic recording instruments and reservoir gauge; and two local lighting panels.

The transformers are placed in cells back of the rear wall of the generating section; the openings to these cells being closed with steel Venetian doors. The transformers are mounted on wheels set on rails whereby they may be moved out into the main room to be handled by the traveling crane. The three sets of three single-phase transformers are each rated at 2333 kw., they are water cooled and have a voltage ratio of 2300 to 55,000 volts, delta connected on both sides. Between the rear wall of the lower building and the front wall of the rear struc- is a space utilized to carry the high tension wiring. The transformer cells include this space but also extend under the first floor of the rear building.

There is a 50-ton electrically operated traveling crane with a 5-ton auxiliary. On the first floor of the rear or switch building are the 2300 volt disconnecting switches; there is also a set of oil circuit breakers for local 2300 volt circuits and a potential reguator.

On the second floor are mounted 2300 volt bus lines against both the front and rear walls, separated by concrete compartments. Down the center of this floor are the 2300 volt oil circuit breakers mounted in brick compartments. There are three type H-9 sets on transformers and four sets of type H-3 sets on the generators, and two sets for the induction motors on the exciters. Connections to these switches are made from the floor below and they are all remote control, motor operated.

On the third floor are the high tension disconnecting switches mounted on timber racks, five sets in front and seven in the rear. The leads from the transformers are brought up through the space between the walls to this floor and then horizontally to the disconnectors. From these the lines are carried to the single high tension busses on the fourth floor. The high tension circuit breakers in five sets are type FE, style H-3 and are mounted in brick compartments on this floor and the lines are carried underneath to them from the disconnectors. There are two outgoing lines, these dropping back from the disconnectors to the horizontal position of the transformer leads, but ascend into and are led out through gables on the roof.



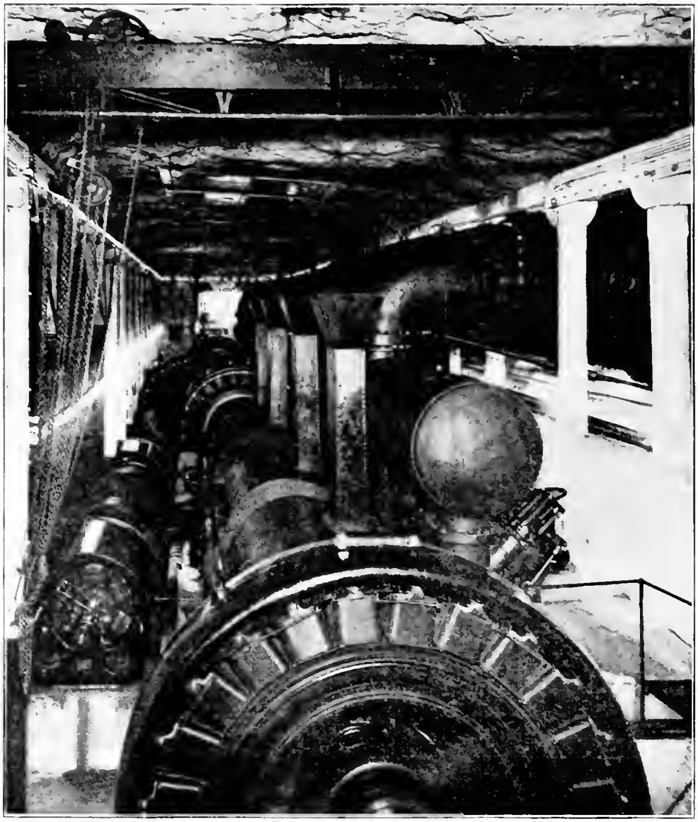
Exposed Water Wheel Runner on Main Unit, Electron.

The Snoqualmie Falls Plant, the pioneer installation for long distance transmission in the Northwest, has helped to form the comparatively short but kalidescopic history of the transmission of the power of water falls to power consuming markets. The visitor to the cavern power house is reminded of the year when this unique and altogether spectacular installation was completed, by a large sign bearing the numerals "1898" in incandescent lamps. Snoqualmie Falls is in the foothills on the western slope of the Cascade mountains, 25 miles due east from Seattle, at a point where the Snoqualmie River after running quietly and almost level for a number of miles, suddenly comes to an abrupt falling away of the hills and plunges in a vertical fall of 270 ft. After a half-mile or so of riffles it again resumes its smooth course. That the fall itself is spectacular and beautiful goes without saying and the whole setting of rock precipices and wooded slopes is one of Nature's masterpieces. There are two generating plants, the second known as No. 2 having been completed within the last year.

Snoqualmie Falls, Dam, No. 1 and No. 2 Intake.

In designating the first plant it was thought that it would be impossible to erect a plant below the falls which would not be more or less affected by the dense spray which rises from the base of the falls. For this reason the power house was placed in a cavern hollowed out of the solid rock, directly under the south bank of the river and back from the brink of the falls a distance of 100 ft. This cavern is 200 ft. long, 30 ft. high and 40 ft. wide. A tail race was excavated the length of the cavern and extending as a tunnel a distance of 450 ft. until it could discharge into the river. This tail race is 24 ft. high and 12 ft. wide. Near the up-stream end of the cavern is a vertical shaft 10 ft. x 27 ft. which reaches to the ground surface on the south bank of the river. Here a double forebay containing vertical bar screens and electrically operated headgates delivers water from the river into two riveted sheet steel vertical penstocks, each 7 ft. 6 in diameter These are placed on either side of the vertical shaft the space between them being occupied by an elevator operating between the ground level and the generating room in the cavern. This elevator is operated by a small tangential water wheel supplied by water from a separate pipe.

One of the penstocks, after reaching the cavern, turns at right angles and extends the length of the generating room, but resting upon a shelf cut into the side of the cavity. From this penstock are four horizontal outlets at right angles, which deliver the water into headers or manifolds and from each of the four manifolds, taken from the under side at right angles, are the feeder pipes, six to each generating unit. The four generating units thus supplied have Westinghouse 1500 kw., revolving armature, three-phase, 2000 volt generators, the sets being arranged, two right-handed and two left-handed, so that two generators are adjacent in the middle and a generator on each end. The generators are direct connected to Doble tangential water wheels. There are 6 runners in pairs in three cast iron housings. These are 45 in. diameter and water is supplied to each runner through two needle regulating nozzles. Type B Lombard governors, water operated, regulate the speed of each unit, which is 300 r.p.m.



Interior of Snoqualmie Falls Cavern Plant.

The two exciter units each have a 75 kw., 125 volt d.c. generator, operating at 460 r.p.m. direct driven by a Pelton water wheel enclosed in cast iron housing, and supplied with deflecting hood over the nozzle operated by a worm gear hand wheel.

At the upper end of the cavern is a more recent unit rated at 5000 kw. This is a Westinghouse, 2000 volt, three-phase generator driven at 300 r.p.m. by

a Platt Iron Works, scroll case, Francis turbine, equipped with a 66 in. single discharge runner. A Lombard type N governor controls this unit.

On a gallery above this unit is the switchboard and also a motor-generator exciter set, the generator being a Westinghouse 75 kw., 125 volt d.c. machine direct driven by a 110 h.p., 2000 volt induction motor of the same make, at a speed of 600 r.p.m.

Transformer House at Snoqualmie Falls.

The switchboard is in two rows on both sides of the gallery and is a Westinghouse equipment, with round dial instruments, having eleven vertical panels and three horizonal superimposed panels. Five panels control generators together with the three upper panels. Of the remaining, three are on transmission lines; one on local lighting; one has a Tirrill voltage regulator; one on switch control for power house No. 2. A blower driven by a 30 h.p. Westinghouse induction motor draws air from the tail race for ventilation, and at the top of the shaft is a similarly driven exhaust fan.

The transformer house for both power houses adjoins the cavern intake. It is a two-story brick building 60 ft. long and 40 ft. wide. On the ground floor, ranged along the south side are six Westinghouse 2500 kw., water cooled raising transformers in two banks. These have a primary winding for 2000 volts and a secondary of 55,000 volts, the lines to both sides being delta connected. On the opposite side are three General Electric 2917 kw. water cooled transformers supplied from No. 2 power house. These transformers have voltage ratios of 60,000/2,000-4,000-6,900 Y, but are operated in parallel with the first named banks. Running longitudinally and near either side wall of the building are two free galleries supported by steel columns, and on these are mounted the oil circuit breakers. Between the galleries and supported by them is a hand operated traveling "horse" crane. A high tension endless bus is carried all around the building above the switches and this is sectionalized at four points with disconnecting switches, so that two consecutive sections have a transformer oil circuit breaker connection to a bank of transformers, and also a similar connection to a transmission line; a third section has an oil circuit breaker transformer connection and the fourth an oil circuit breaker and line connection for the Everett line. On the No. 2 transformer feeders is a Westinghouse type G. A. oil circuit breaker solenoid-operated and controlled from power house No. 1. With it are mounted two series transformers and time limit relays. For the Everett line, a simlar circuit breaker set is provided. On the south side, two sets of transmission line circuit breakers are again similar, but the two sets of transformer circuit breakers were supplied by the Pacific Electric Company of San Francisco.

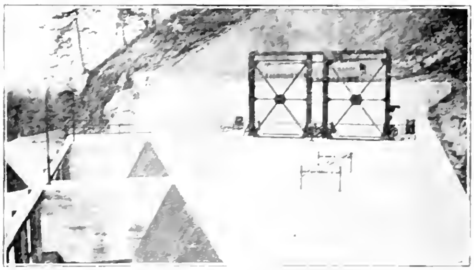
Placed on a heavy framework outside of the transformer house are General Electric aluminum electrolytic lightning arresters with horn gaps, connected to each outgoing 55,000 volt line.

In an adjacent building is an ample storeroom and a shop containing a shaper, machine lathe and drill press and two 3-crank plunger pumps driven by 10 h.p. induction motors for supplying water to the various buildings, cottages, etc.

The track of a branch of the Great Northern Railway passes the transformer house and a branch track is continued from the opposite bank of the river down an incline to power house No. 2. A car ferry consists of a scow controlled by cables, there being on either bank a track-apron which may be raised or lowered depending upon the height of the river and which will allow cars to be run on to the ferry.

The intake of the No. 2 plant is placed immediately above the low dam near the brink of the falls on the opposite side from that of No. 1. This intake is 85 ft. long between two concrete bulkheads with a 5 ft. wide concrete pier in the center. In each opening are four gates, closed with planks sliding between vertical channels and behind these are vertical bar screens having a 1 in. separation. The concrete walls converge to the mouth of the tunnel before which there are two rectangular gates 10 ft. wide sliding in channel guides and hand operated by rack gears. Each gate has at its center a small 21 in. gate for filling the tunnel when empty.

The tunnel has a length of 1035 ft. and is excavated in a curve through the spur which forms the north bank of the river extending some distance past the falls. It has a circular section, the excavation being made approximately 14 ft. in diameter. This was lined with concrete, leaving a finished diameter of 12 ft. It is calculated that with a loss of head at 5 ft., the



... of No. 2 Snoqualmie Plant.

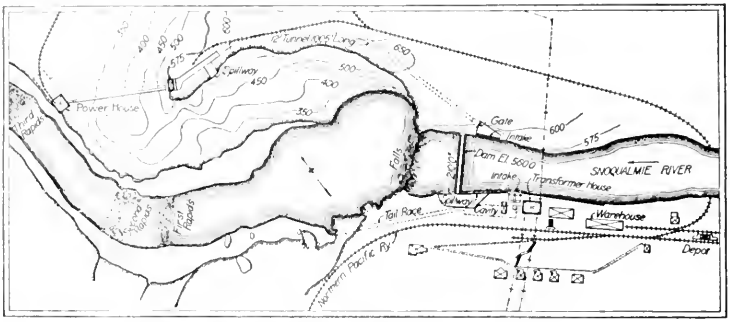
tunnel will carry a flow of 1340 second feet. Water is delivered into an open canal, excavated in rock a distance of 220 ft. to the forebay of power house No. 2. This canal has a bottom width of 20 ft. and is unlined. At one point a notch has been cut through the spur for a spillway from this canal; this is 30 ft. wide and discharges into the river below the falls.

The forebay is of reinforced concrete and is set across the end of the canal, the water passing into it

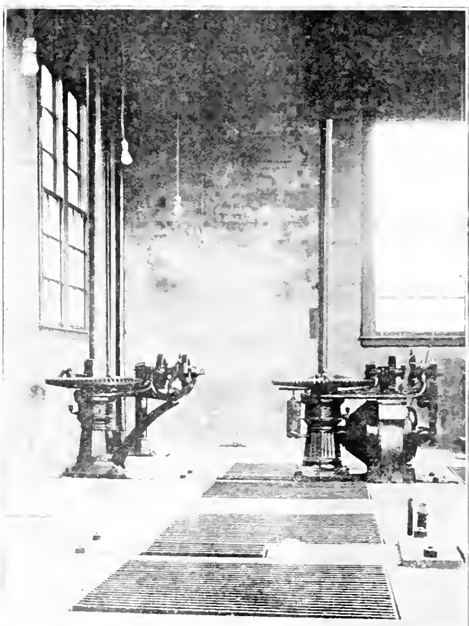
Canal and Forebay of No. 2 Plant.

through the conventional steel screens set on a slight incline to the vertical.

Openings are provided for three pipes, it being proposed to eventually install three generating units, but one pipe now being installed. The flow is controlled by two Coffin sluice gates in tandem, each 8 ft. in diameter the first one being an emergency gate, with screw stem, manually operated; it is also provided with a trip arrangement, which, by opening the supporting nut, will allow the gate to drop by its own weight. This trip is operated by a wire run inside of a pipe from the power house. So far there has never been an occasion requiring the use of this emergency device. The other gate is operated from the power house by a 10 h.p. induction motor. There is a 24 in. by-pass gate, manually operated for filling the pipe line. The gate house is of reinforced concrete 50 ft. long and 15 ft. wide.



Plan of Power Development of Snoqualmie Falls.

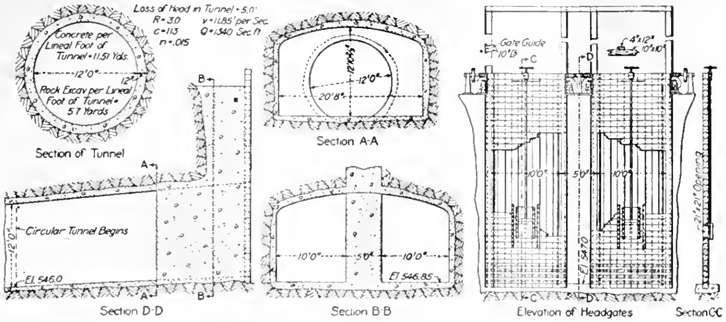


Interior of Forebay Gate House of No. 2 Plant.

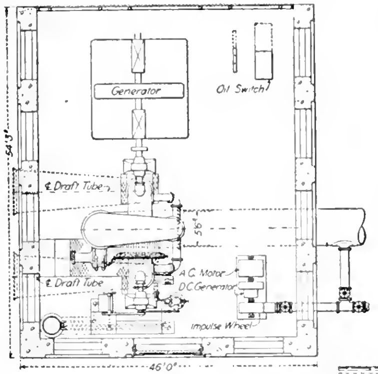
The pipe or penstock has a diameter of 7 ft., is of riveted sheet steel and varies in thickness from 3/8 in. at the top to 7/8 in. at the power house. It is supported and fastened to heavy concrete anchorages. The length of the pipe is 466 ft. The head is 255 ft.

The power house is of reinforced concrete of a modern and pleasing but conventional classic design. One end is left unfinished, a corrugated iron wall being used, and the future addition will continue the building from this point. Its position is close to the river and the draft tubes of the water wheel discharge directly into the river, they being carried low enough to be submerged at the period of lowest water. The building is 40 ft. wide and at present 50 ft. long. The roof is of concrete supported on Howe steel trusses, spaced 10 ft. apart; throughout its length a 50-ton, electrically driven Niles traveling crane operates.

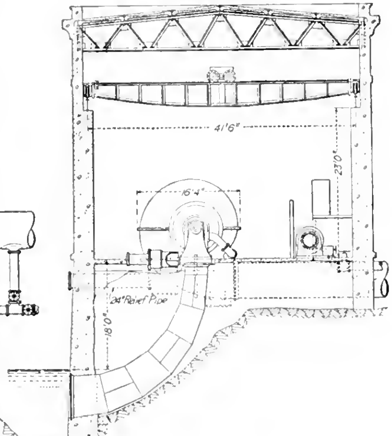
The main generating unit consists of an 8,750 k.v.a. General Electric generator, the armature being Y connected to deliver 6900 volts, driven at 360 r.p.m. by an I. P. Morris double discharge, scroll case, single runner, Francis turbine. The hydrostatic head on this unit, including the draft, is 270 ft. The governor is of the double floating lever type built by the water wheel maker. A three-crank oil pump for actuating the governor is belted to the main shaft of the unit. On test this water wheel developed 12,500 h.p. with full gate opening and has a guaranteed efficiency of 82 per cent while delivering 8000 to 10,000 h.p.



Sections of the Tunnel at the Intake

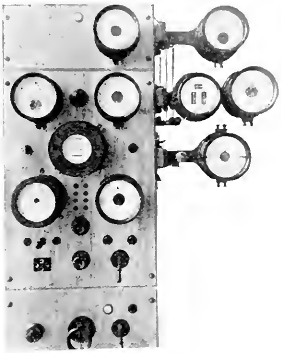


Plan of the Power House

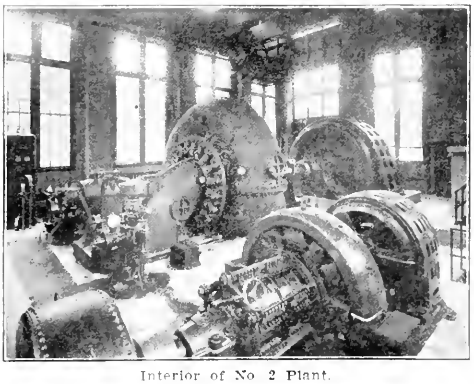


Section through the Turbine

The exciter is a 200 kw. General Electric, 125 volt d.c. generator, driven on the one side by a 300 h.p. Doble tangential water wheel, supplied with a hand regulated needle nozzle; on the other end is connected a 300 h.p. General Electric 2000 volt three-phase induction motor. This set has five bearings, there being but one on the outer side of the water wheel; it operates at 450 r.p.m.


Switchboard at No. 2 Power House.

The switchboard of one panel of blue Vermont marble was furnished and equipped by the Westinghouse company and is of a most recent type. It is mounted on a raised platform under which are the generator bus and disconnecting switches in concrete cells. In the basement are placed two type B Westinghouse oil circuit breakers, one on the generator circuit and one on the transformers supplying the ex-


Interior of No. 2 Plant.

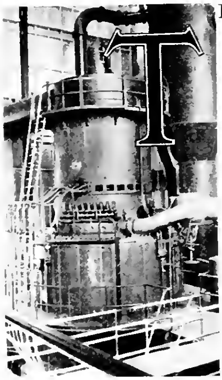
Snoqualmie No. 2 Plant.

citer motor. The latter are also mounted in the basement and consist of three General Electric 85 kw. transformers wound for 6900 to 2000 volts. At another part of the basement entered by stairs are a storeroom and a lavatory. These basements are the spaces formed between the machine foundations and the walls of the building. The 6900 volt, three-phase current from this power house is carried on two circuits on a pole line to the transformer house above the falls.

The watershed for the Snoqualmie system covers an area of about 400 square miles and extends in an easterly direction from the falls a distance of 25 miles to the ridge of the Cascade range. Much of this territory is in the Snoqualmie National Forest reserve and the altitude reaches to 7500 feet; it is heavily timbered. A number of lakes having areas of from one to three square miles form the headwaters of the Snoqualmie River and these discharge into three branches which meet about three miles above the falls. The rainfall varies as the elevation and increases from 60 inches at the falls to 120 inches at the highest altitude. Most of the precipitation occurs in the winter months. During the summer months the natural flow has a minimum value of 550 second ft. The total annual flow at the falls is about 1,800,000 acre-feet which is equivalent to an average precipitation over the watershed of 85 inches. It is proposed to utilize the possible storage facilities to conserve this flow and this will make possible a continuous discharge at the falls of 2500 second feet available for power purposes, which would generate 50,000 horsepower.

The watershed for the Electron plant covers an area of about 100 square miles, extending from the intake on the Puyallup River to the summit of Mt. Ranier. Above an elevation of 5000 ft., the canyons and ridges are covered with perpetual snow and ice and the contact of the moisture laden winds from off Puget Sound with this frozen covering is the cause of a heavy annual precipitation, estimated as high as 140 inches. These fields of ice and snow in the form of glaciers, of which there are five, ceaselessly moving down their respective ravines, are the source of the streams which go to make up the Puyallup River. The watershed is rough and very heavily timbered below the main mountain.

STEAM GENERATING PLANTS.



Turbo-Generator at Georgetown P. H.

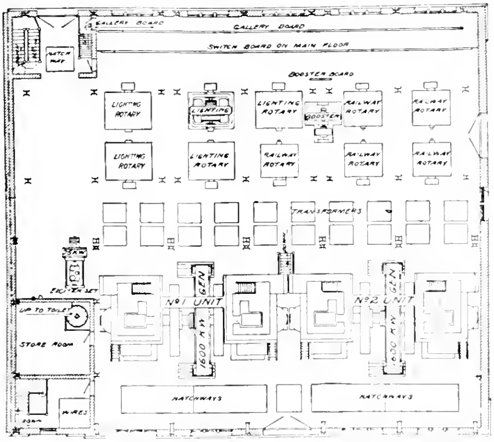
THERE are seven steam generating plants in the system, all of them, with one exception, having been originally central station plants, operating systems of their own without assistance from transmitted power. They are all now held as auxiliary or standby plants to be used only in case of failure of transmitted power. These plants are the Post Street, Georgetown and Diamond Ice Company power houses in Seattle, the central station power house at Everett, stations "A" and "B" at Tacoma, and York Street station a Bellingham.

Post Street Power House is a relic of the "days of steam" and was in its time a fine example of central station practice. It is now probably the busiest distributing point on the system, but not in the manner of a few years back when steam was the mainstay of the system. The station is situated within a block of the water front, where the transportation of fuel is an easy matter, in the most congested section of the lower commercial district. The building, equivalent in height to about five stories, is of pressed brick and covers about half a block. Starting at the top, the steel coal bunkers, having a storage capacity of 400 tons, are at the highest level. Coal is delivered into the bunkers by a bucket conveyor just outside of the building. This conveyor is loaded below the street level. Cars loaded with coal are dumped through an opening in the street into a pit in which is a coal breaker driven by a steam engine. The coal, after passing through the breaker, is loaded into the conveyor which is also operated by the engine.

The six Babcock & Wilcox boilers rated at 500 h.p. each, are on the upper floor. They are fed by Greene mechanical stokers which are driven from a shaft in turn operated by a General Electric 10 h.p. induction motor and also by a steam engine in case of emergency. Renton nut coal and screenings are used from a mine owned by the company. There are three Simmance-Abady CO_2 recorders, and draft gauges and recording thermometers on each boiler. Three Platt Iron Works high duty and one two-cylinder, induction, motor-driven pumps supply the boiler feed water. There are also two large steam driven feed pumps which get water from an artesian well, in case the city supply is inadequate.

The engine room is on the west side of the main floor. The two main engines are MacIntosh & Seymour vertical, double tandem compound units operating at 120 r.p.m.; between each pair of engines is a 1600 kw. two-phase 2300 volt alternating current generator. Over the engine units is a 50-ton electrically operated traveling crane.

An extensive steam heating system is operated

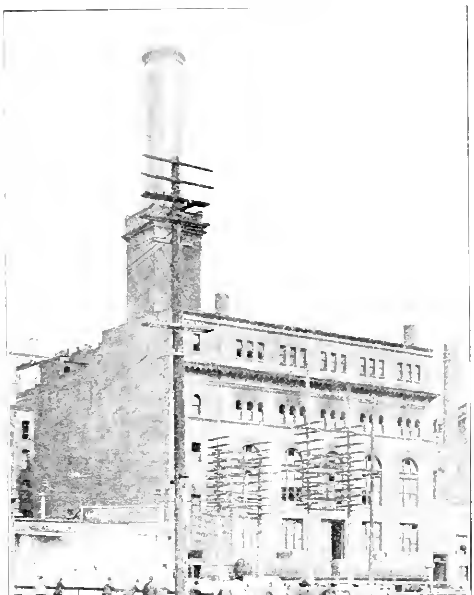


Plan of Post St. Station at Seattle.

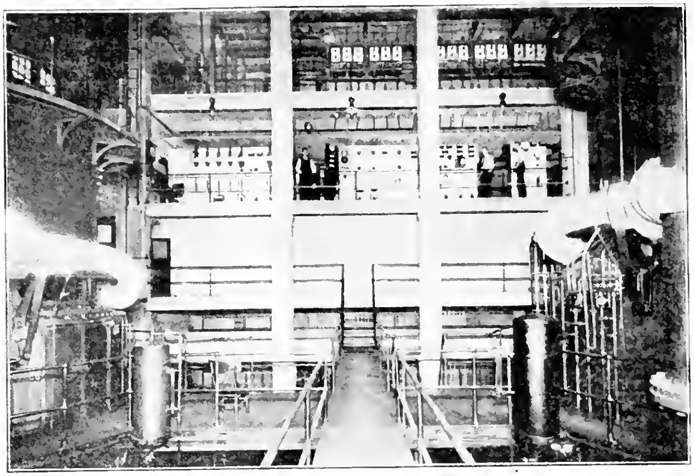
from this station and exhaust steam from the engines is fed into this system in accordance with the demand for heat. The station pressure on this system is 5 to 11 lb., the intention being to maintain a constant pressure at the farthest point of 2½ lb.

A 75 kw. 250 volt d.c. exciter operating at 200 r.p.m. is driven by a simple Ideal engine.

A large part of the main floor space is taken up with rotary converters, of which there are ten and one battery booster. Five of these rotaries are Westinghouse 500 kw., the a.c. side being three-phase, the d.c.



Post Street Station at Seattle.



View of Switchboard and Switches in Georgetown Power House.

Switchboard in Georgetown Power House.

side delivering 550 volts and the machine operating at 400 r.p.m. There is mounted on the end of the shaft a 40 h.p. induction starting motor. The remaining rotary converters operate at 360 r.p.m., deliver d.c. at 250 volts and are rated at 500 kw. A 20-ton traveling crane is provided for handling the rotaries and one of 10 tons capacity for transformers.

The battery booster or charging set is General Electric and is used for charging individual cells of the lighting battery. The motor is 50 h.p. and the delivered voltage 0-120 volts.

The switchboard is arranged in two rows, one above the other, on a gallery across one side of the building. The main floor switchboard controls both the a.c. and d.c. sides of the rotary converters, the storage batteries and booster, T. A. voltage regulator or engines and power circuits from other substations. The upper switchboard controls the Edison three-wire commercial circuits and the railway feeders, the equipment throughout being blue marble panels and General Electric standard instruments.

In the basement is a type H storage battery of 154 cells, furnished by the Electric Storage Battery Company. It is in two compartments of 77 cells each. There are 34 end cells on each side. The cells of this battery are made up of 69 plates each. It is used in connection with the Edison three-wire system, but only in case of emergency. It has a discharge rate of 4800 amperes. There are two end cell switches arranged to operate separately or in parallel, these, at the time of installation being said to be the largest switches of their kind in existence. A 24 in. wood-stave stack ventilates the battery room.

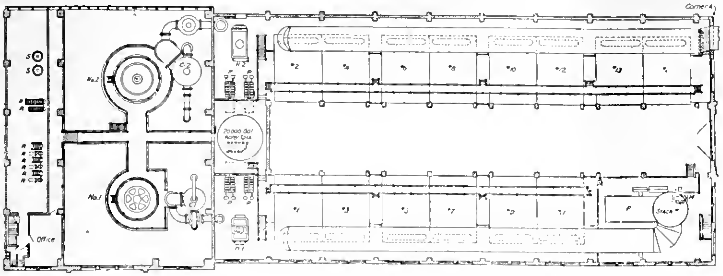
All feeders are carried from the basement into two manholes under the street, the one containing 64 ducts and the other 40. All feeders are in lead covered cables save a few Edison tubes still in use, which are gradually being eliminated. All lead sheaths whether for railway, Edison three-wire or 2300 volt service are grounded to the railway negatives.

Georegtown Power House is a modern steam plant, built only to supply power in large quantities to the various substations and used constantly under forced load until the advent of the White River hydraulic plant. This plant is situated on a large tract of ground adjoining the car repair shops at the southern extremity of the city of Seattle. The plant is in two sections, the one containing the boilers and the other the two turbine generating units, the whole covering a ground space 140 ft. long by 80 ft. wide. The building is a heavy reinforced concrete column and beam structure with heavy curtain walls of the same material. Detched from the boiler end and connected thereto by a flue is a reinforced concrete chimney.

The boilers are arranged in two parallel rows with a firing floor down the center. There are fourteen 460 h.p. Stirling water tube boilers with spaces for two additional on each side. It has been found possible to deliver 15,000 h p. from the turbines deriving steam from the 14 boilers installed. Oil fuel is used which is purchased from the Standard Oil Company. Above the boilers is a heavy reinforced construction to provide for coal bunkers, as it was thought when this station was built that coal fuel might become an eventual necessity.

There are four Blake feed pumps with cylinders 14 in. x 9½ in. x 12 in.

The engine section contains the two Curtis vertical turbines, one being 8000 kw. and the other 3000 kw. Each turbine has an overload capacity of 50 per cent for a period of two hours. Barometric condensers are used. A 50-ton electrically operated Northern Engineering Company traveling crane operates across the building over the turbines. On the floor of the turbine room are two Weiss air pumps built by the Southwick Foundry & Machine Company. There are also two Southwick centrifugal circulating pumps driven by Porter Allen engines; two oil feed pumps; four pumps for auxiliaries and one motor driven pump; one air compressor oil filters, tanks, etc.



Plan of Georgetown Power House.

At the end of the turbine room is one 3-bearing motor-generator exciter; a 175 h.p. induction motor driving a 120 kw. 125 volt d.c. generator at a speed of 60 r.p.m.; one 75 kw. 125 volt d.c. exciter driven by a Porter-Allen simple engine at 270 r.p.m. For railway service there are two motor generator sets of 500 kw. capacity, these being the standard 514 r.p.m. sets used by the company, who put in interpoles after the sets had been in service four years. These sets supply power to the Seattle end of the Tacoma interurban system and the local street railway in the immediate district.

There are two 500 kw. General Electric water-cooled transformers reducing from 13,800 volts three-phase to 2300 volts two-phase for local power distribution, and two 100 kw. similar transformers for station service.

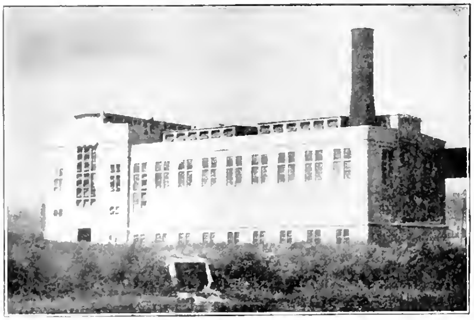
The switchboard is placed on a gallery over the motor-generators and transformers and consists of twenty-three blue marble panels. It is of standard General Electric type with horizontal edgewise and graphic recording instruments. There are two panels on the turbines; two on 13,800 volt feeders; one on 500 kw. transformers; three on 2300 volt power and lighting; five on exciters; one on T. A. voltage regulators; four on motor-generators, a.c. and d.c.; and five on railway feeders.

On a second gallery are placed nine sets of General Electric H-3 motor operated oil circuit breakers mounted in brick and concrete compartments. These control the outgoing 13,800 volt three-phase circuits. Of these there are two 0000 circuits, one of which goes to the Massachusetts Street substation and the other to the James Street substation; each of these feeders has a capacity of 6500 kw.

On the third gallery there are two General Electric K-4 oil circuit-breaker sets in compartments, caring for the railway motor-generator circuits. Two sets of aluminum cell lightning arresters on the outgoing lines complete the equipment of this station.

Cold air for ventilating the turbines is drawn through steel ducts from outside the building near the ground.

Diamond Ice steam plant situated in Seattle, close to the Union Street substation on the waterfront in the downtown commercial section, has recently been added to the system, originally being an isolated plant supplying its own network in the commercial section of the city, owned and operated by the Diamond Ice Company in connection with the ice-making system. The power equipment consists of three steam generating units, the first rated at 1000 kw. driven by a Reynolds cross compound Corliss engine, the other two being DeLaval steam turbo-generator units of 200 kw. each and delivering 250 volts into the Edison three-wire system. One 300 kw. and one 500 kw. rotary converter both also supplying the three-wire system complete the power equipment of this plant.



Georgetown Generating Plant.

Everett steam generating plant occupies a strategic position for fuel and power delivery, and when built represented a high class of steam plant design and finish. While it is held ready for operation at all times, it is used now only as a standby or emergency station. The plant is housed in a large square brick building of ornate design and is divided into two main sections, the one containing the boilers and accessories and the other the engines and electrical apparatus.

In the boiler room are two 450 h.p. and two 256 h.p. Babcock & Wilcox water tube boilers. Coal is delivered under the boilers by Greene automatic stokers which are driven by a small engine. There are two Worthington vacuum pumps and two feed pumps of the same make. On the wharf, a short distance from this station, is a three-cylinder, two-stage condenser pump, driven by a Westinghouse 25 h.p. type M., d.c. motor. In the boiler room is a New York blower for furnishing draft, driven by a Westinghouse 15 h.p. d.c. motor.

In the generating room there are two engine and one turbine steam generating units. The engines of the reciprocating units are similar, Allis-Chalmers, 750 h.p. Corliss type, one driving a 500 kw. Westinghouse

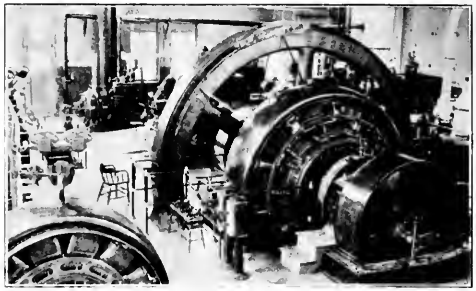
d.c. 600 volt railway generator, the other a Westinghouse 500 kw. 2200 volt, two-phase a.c. generator. The third unit is a Westinghouse-Parsons turbine of 750 kw. operating at 1800 r.p.m. and this delivers two-phase current at 2200 volts. A 25 kw. 55 volt d.c. exciter for the turbo-generator is direct connected to and driven by a two cylinder 8½ in. x 8 in. Westinghouse "Junior" engine.

Everett Steam Plant.

The switchboard is of marble and has thirteen panels, these being divided as follows: three on generators, one on exciter, three on rotary-converter, two voltage regulators; two railway feeders and two on arc circuits.

One Westinghouse 250 kw. rotary-converter for railway service is in use here. There are finally two large Worthington steam pumps connected to the city water works system. One of these pumps placed on the engine room floor is double tandem compound and has a capacity of 3,000,000 gal.; the other is of the same type but one-half the capacity and is placed in the basement under the engine room.

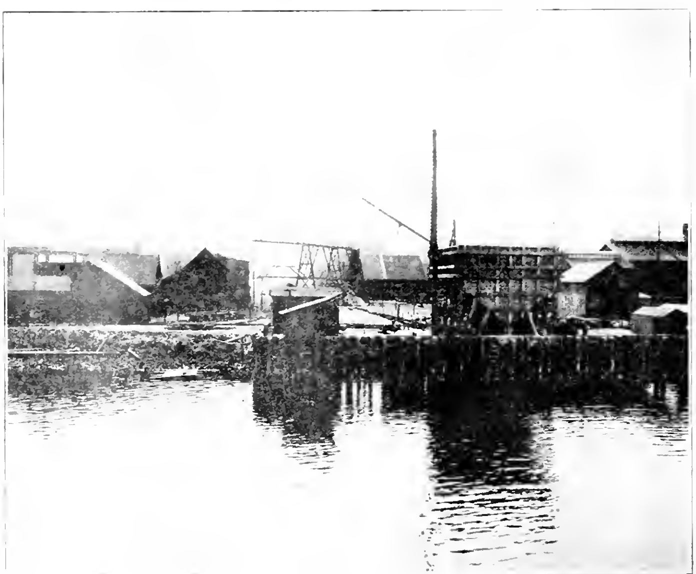
The Tacoma steam generating plant, station "A," is the principal steam plant of the city and is also a transformer substation. Like the others the steam plant is used only for emergency service, with the exception of the cable engine which is used in starting the cable which is driven by an induction motor. Even this service will be soon discontinued as it is proposed to install a motor of greater capacity capable of starting the cable.



Interior of Everett Steam Plant.

This station is situated at the commercial center of the city and adjacent to the Northern Pacific tracks and also the water front. It is a brick structure and adjoins the car houses and repair shops. At one end are the executive offices governing this division of the system.

Two transmission lines from the Electron and White River power houses enter this plant from the rear and, after passing through General Electric type H-3 motor operated oil circuit breakers, connect to a bus line. From this a circuit is carried through disconnectors and H-3 circuit breakers to one bank of two transformers. There is one spare transformer. These are General Electric, water cooled, 55,000 to 2300 volts and are T connected for two-phase second-



Tacoma Smelter.

ary. A 200 kw. General Electric transformer compensator is inserted in one phase to give a true two-phase circuit. There is also a 400 kw. non-automatic General Electric potential regulator on the 2300 volt feeders.

For the 13,800 volt supply to the Fern Hill steam plant, substation "B" and the Northern Pacific shops substation "C," there are four 500 kw. 2300 to 13,800

Station A at Tacoma.

volt raising transformers. There are two sets of 11-3 motor operated circuit breakers, one on the raising transformers and the other for the main 2300 volt station circuit.

Carbon gap lightning arresters protect the incoming transmission lines.

The main engine space which occupies the space on the street side of the building is arranged with a jack shaft driven through two pulleys and rope drives from two Frick horizontal tandem compound engines of 750 h.p. each. The drives are of 2 in. continuous manila rope, each consisting of fifteen loops. At either end of the jack shaft is a clutch. Engaging the north end clutch and lined with the jack shaft are two 850 kw. General Electric synchronous motors, rigidly connected.. Similarly placed, but at the south end, are two 850 kw., d.c., 600 volt railway generators. Beyond these is a clutch which engages another driven pulley, which is driven by a Cooper 1000 h.p. horizontal cross compound engine.

Between the jack shaft and the front of the building, its shaft approximately in line with the shafts of the other engines, is a Pennsylvania horizontal Corliss engine direct connected to a Stanley, inductor type, 500 kw., two-phase a.c. generator.

The cable system is fitted with a 200 h.p. horizontal Corliss engine, but is regularly operated by a General Electric, variable speed, 100 h.p. induction motor .

The switchboards, in three sections, have two rows of panels facing each other and the third section at right angles in the rear of the switchboard space. There are altogether forty-five blue marble panels; five on commercial feeders and lighting; two on exciters; two on motor generator, a.c. and d.c.; three on synchronous motors; one on cable motor; seven on railway generators; five on oil switches; one booster; one totaling instruments; one bus multiple and seventeen railway feeders.

There is one four-bearing exciter set consisting of a 60 h.p., 2300 volt induction motor and a 125 v., 40 kw. d.c. generator, the speed of this unit being 605 r.p.m.

For railway service there are two 500 kw. motor generator sets. These operate at 400 r.p.m.; the motor is synchronous, 750 h.p. and operates at 2200 volts, two phase. The generator is an eight pole, 600 volt d.c., both being General Electric.

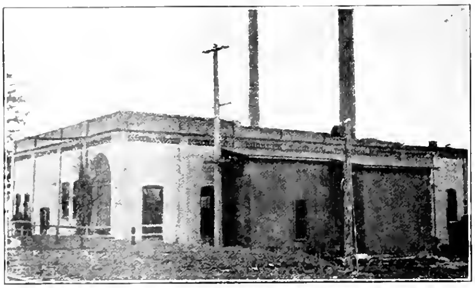
Fern Hill Substation and Steam Auxiliary, Station "B."

This plant is located several miles south of the center of the city but within the city limits, on the Spanaway railway line. It was built for railway service. The plant is housed in a one-story brick building, 80 ft. x 125 ft. In a recently constructed addition there are placed two General Electric 300 kw., 13,800 to 2300 volt, water cooled transformers for supplying two-phase current to one of the motor generator sets. Three sets of solenoid operated, General Electric type, K-12 oil circuit breakers mounted in cells are provided on the incoming 13,800 volt line, the other two operating on machine compensators. The circuits from the transformer house to the machines are carried under the floor in lead covered cables.

There are two motor generator sets, each having a capacity of 500 kw. One of these is a standard 514 r.p.m. set as used at other stations, and operating direct from the transmission line. The other is driven by a 700 h.p. synchronous, two-phase, 2300 volt motor at 400 r.p.m.

On the steam units there is one General Electric 200 kw., 550 volt, four pole, d.c. generator, belt driven by a Sioux City 350 h.p. Corliss engine and two old d.c. Edison bipolar, 500 volt generators of 100 kw. each, both belted to a 450 h.p. Stearns Corliss engine.

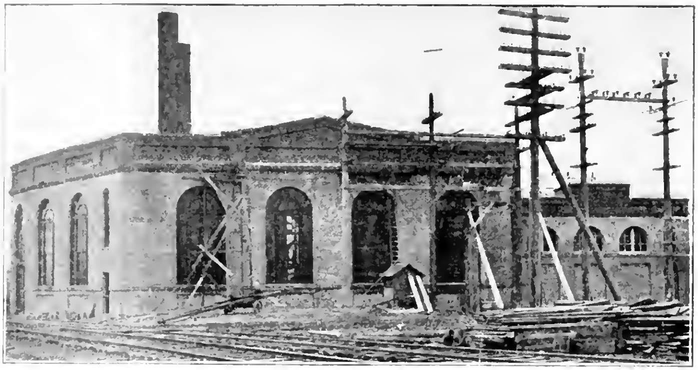
The boilers are ranged across the rear of the building, there being three 100 h.p. Phoenix 60x18, return tubular boilers and three 125 h.p. Stearns, 72x16, of similar type. This station receives its current supply over a single 13,800 volt circuit from Station "A."



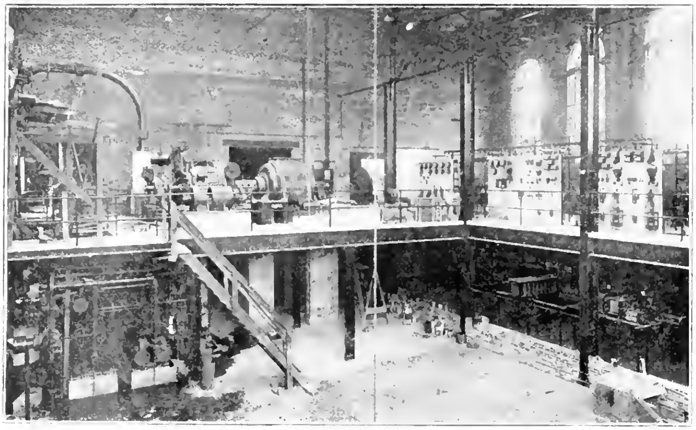
Cornhill Station at Tacoma.

Bellingham York street station is a modern steam generating plant and contains also the step down transformers of the transmission line from Nooksack Falls.

The building is of brick with steel columns and steel and concrete floors. There are three Stirling water tube boilers of 505 h.p. each, fitted for burning oil, and two Warren 12x7x12 feed water pumps. There are two generating units, one being a Curtis 2000 kw. horizontal turbo-generator, operating at 1800 r.p.m. and delivering three-phase current at 2300 volts. The turbine exhausts into a Helander barometric condenser. A 35 kw. Curtis turbo-d c. generator exciter is provided for this unit. The other unit is a 1000 h.p.



York Street Station at Bellingham.



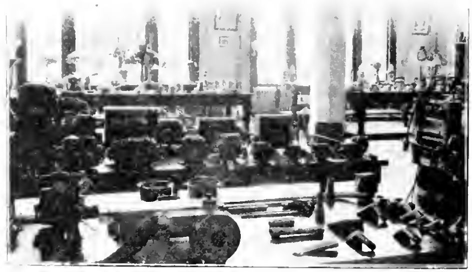
Interior of York Street Station at Bellingham.

Hamilton Corliss horizontal, cross compound, non-condensing engine, belted to a pulley which is connected through a clutch to a 500 kw., two-bearing, standard synchronous motor-generator set. This belt is three-ply and 72 in. wide and the driven pulley is 36 in. diameter. There is a second motor-generator set operating independently of the same size and specification. These supply current to the local railway system and the Bellingham end of the Skagit interurban line. The transformers are enclosed in an addition to the main building which also contains the Hamilton engine. The local distributing system is three phase for power and single phase for lighting.

The company also operates the gas works in Bellingham. Lowe crude oil and water gas apparatus is installed here. The annual output is about 40,000,000 cu. ft. There are thirty-five miles of low pressure mains.

Show Rooms.

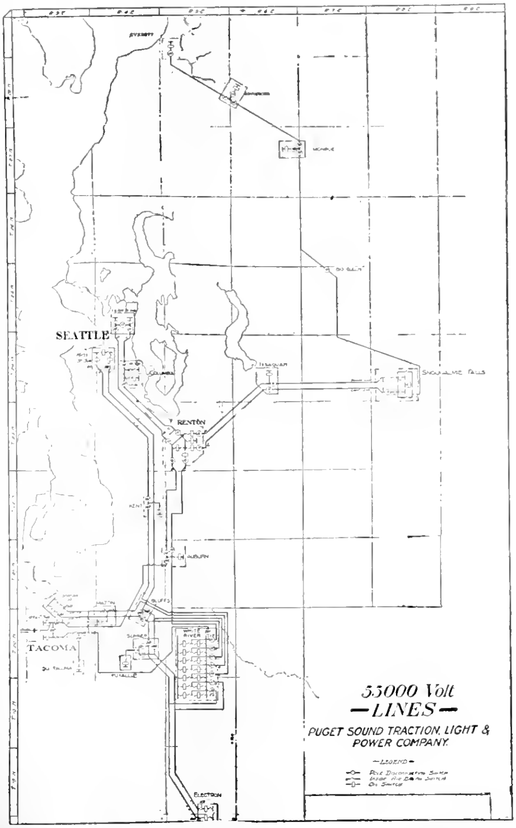
At all of the principal offices current consuming devices of every description are displayed for sale. The views below are of a very elaborate show room and an exquisitely furnished apartment, completely equipped in every one of its five rooms with electrical devices; all at the Seattle office.



TRANSMISSION LINES.

Typical Steel Tower Transmission Line Construction.

ORIGINALLY there were three distinct transmission line systems, two of which have now been brought to operate together. These are the system deriving power from Snoqualmie Falls and the one supplied from Electron and the Bellingham system from Nooksack Falls. The first two are now interconnected. There is no connection to the third. The two first named transmission systems are operated at a potential of 55,000 volts, delta connected at the transformers, are three-phase and 60 cycle. The Bellingham system, otherwise similar, operates at 38,000 volts. Throughout, native fir poles are used, spaced about 125 ft. apart, although in some cases, double this spacing has been recently made. A few miles of "A" frame steel towers have recently been installed on lines leading from the White River plant. All transmission lines carry a single circuit arranged in an equilateral triangle, one wire being mounted on a steel pin at the pole-top, the other two at the ends of a cross arm. Line construction is standard and telephone circuits are carried on an arm below the power wires. Steel pins and 4-part brown porcelain insulators are used. Secondary transmission lines operating at 13,800 volts are extensively used in Seattle and for supplying various outlying railway substations.



From Snoqualmie Falls are two parallel transmission lines, each carrying a single circuit of No. 0 aluminum strand to Renton switching station; from this point two parallel similar lines each No. 00 aluminum strand go to Tacoma and two to Seattle. In the former city the lines terminate at the main substation, one of them however having a loop into the White River power house. A third line of No. 4 copper is carried from Snoqualmie Falls to Everett, a distance of 40 miles being tapped into the substations at Monroe and Snohomish and terminating at the Everett substation.

From Electron are two transmission lines of No. 0000 copper quite similar to the preceding. These lines are carried to Puyallup, where they branch to two lines of No. 00 copper, going to Tacoma, and two lines of No. 0000 copper to Seattle. The former terminate at Station "A," the main steam generating plant. In Seattle, the lines terminate in the Massachusetts street substation. All other substations are supplied from the secondary 13,800 volt transmission lines.

A very complete telephone system is operated over the entire system. This is controlled from the central switchboard at Seattle, where the load despatcher has control of the operation of the entire system and is in telephonic communication with all points, in most cases over a number of different routes. There are three load despatchers, each having two shifts of four hours. At various points are secondary switchboards, where an operator has supervision of a local telephone system.

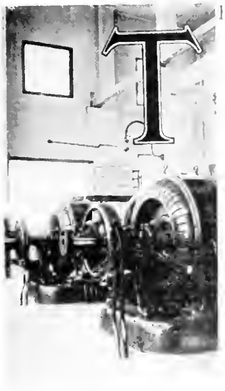
The transmission lines are protected at switching points by aluminum cell lightning arresters. There are also in use a number of carbon resistance type lightning arresters.

The rights of way for transmission lines in open country in some cases follow county roads, or the right of way of the interurban lines. Much of the line is, however, through the forest and here it is necessary not only to make an unusually wide clearing due to the great height of the native timber and the danger of its falling across a line, but it is also necessary to clear it every year from the rapidly growing brush growth, to prevent the spreading of forest fires which are a serious menace in this country.

Poletop disconnecting switches are installed wherever a connection is made to the transmission circuit.

The transmission line from Nooksack power house to Bellingham has a length of 40 miles. This line has a single circuit of aluminum strand equivalent to No. 2 copper. The insulators are standard 60,000 volt porcelain. The poles are native fir and are spaced 145 ft. apart and are 45 ft. long. This line follows a railroad or a county road for the greater part of the distance. At the present time it is being operated at 38,000 volts star connected at the transformers.

SUBSTATIONS.


Interior of Union Street Substation

THE combined system includes 32 substations of which 13 are supplied directly from the 55,000 volt transmission lines, 9 from the high tension transmission of the Bellingham system and the remaining 10 are furnished with current from other substations at 13,800 volts and are therefore only used to supply a nearby local demand. In addition to these, two cable stations are substations only in the sense that they receive electric current to drive the cable motor.

In the type and design of substations there has heretofore been no one standard, but rather several types, as these stations have been constructed not only at different periods, some of them having been built in the early days of power transmission and therefore showing evidences of many changes, but also by the various companies which have now come under the general supervision of Stone & Webster. For this reason it will be impossible to describe any one substation as a type. On the contrary, much of the machinery with which the stations are equipped is similar and shows more or less standardization.

With the exception of six substations on the Snoqualmie system, they are equipped for railway operation and have one or more motor generators or rotary converters. There are in use a total of sixteen rotary converters, these being some of the earliest of the railway equipment, but it has not been the policy within recent years to use this type of rectifier. The motor-generators as now standardized are in two capacities, 1000 kw. and 500 kw. These sets have


Snoqualmie Substation at Seattle.

two bearings, operate at 514 r.p.m., the driving motor being of the synchronous type. The generator is eight-pole with interpoles for the larger size only, delivering full load current at 600 volts. The motor is equipped with a squirrel cage winding in the pole faces for starting and are supplied with three-phase current at 13,800 volts. The motors of the larger sets are rated at 1440 h.p., while the smaller sets are rated at 700 h.p. The make is General Electric.

As the distributing systems are all two-phase, two lowering transformers are used in every set, the Scott three-phase-two-phase connections being used. The transformers are of various types so that individual description will be necessary.

Switchboards are largely General Electric standard modern types, although there are a number of Westinghouse switchboards of modern type on the Snoqualmie system. Time limit relays are used on all incoming circuits.

Oil circuit breakers, whether they be for 2300 volts, 13,800 volts or for 55,000 volts are either motor or solenoid operated by remote control from the switchboards, lever connection control being occasionally used in the older stations. All oil circuit breakers are protected, if on 55,000 volt lines, by double break disconnecting pole top switches outside of the substations. In nearly all cases bar type disconnecting switches are also provided directly above the oil switch. The oil circuit breakers on the high voltage lines in the older equipments are General Electric type H-3 mounted in brick cells and motor operated, the leads being brought up through the floor from below; Pacific Electric 4-break automatic trip or hand operated breakers are also found. The newer installations are equipped with General Electric K-10 and K-15 solenoid operated circuit breakers.

Most of the substations are protected from lightning, if on a high tension circuit, the older installations being provided with carbon gap arresters, the newer with General Electric aluminum cell electrolytic lightning arresters.

A description of each station follows, grouping them in their localities:

Seattle Substations.

Seattle has two groups of stations, each with individual distribution networks. The Snoqualmie system has but one substation and receives 55,000 volt three-phase current from the hydrolectric plants of that system. The other group of six substations receive three-phase current either directly or indirectly from the Electron and White River hydroelectric


Interior of Snoqualmie Substation at Seattle.

plants and from the Georgetown and Post Street steam plants. The 13,800 volt and 2400 volt distributing systems are more or less interconnected and the 55,000 volt lines may be all thrown together at the White River power house.

The Seventh and Jefferson Street substation of the Snoqualmie system and the Massachusetts substation of the second group receive main line 55,000 volt current, the latter supplying 13,800 volt current to all of the other substations. Three of the recently constructed substations represent the most modern practice, Union Street, North Seattle and Ballard.

The Seventh and Jefferson Street substation is pretentious and was built during the early days of power transmission, being part of the system receiving power from Snoqualmie Falls. Until recently this substation has supplied a distributing system in competition with the other stations. Since its start in 1898 there have been a number of changes made and the capacity has been increased from time to time. The building commands a fine view over the commercial portion of the harbor and while on a side hill is in the very center of the city. It is of brick with considerable attempt at architectural adornment. The main floor is occupied by three rotary converters. These have a capacity of 500 kw. and deliver direct current at 550 volts. On a line down the center of the main floor is a Westinghouse switchboard of 25 panels. This switchboard is of white marble, on which are mounted round type instruments and Bristol recording instruments. Nine panels control 2200 volt, two-phase light and power circuits; one is for 13,800 volt, three-phase power; two are on transformer and bus multiple switches; one on the voltage regulator, three on the a.c. side of the rotary converters, three on the d.c. side of the rotaries, two are 600 volt d.c. railway panels, and two 500 volt d.c. commercial panels.

The two incoming transmission lines enter through porcelain tubes supported in glass panels and pass directly to Pacific Electric oil circuit breakers placed on the floor in the rear of the switchboard.

In the basement are placed the lowering transformers and potential regulators. The four 2500 k.v.a. Westinghouse water-cooled transformers are arranged in two banks, being Scott connected on the high tension side for 55,000 volts three-phase and on the low side for 2200 volts two-phase. There are also two 500 k.v.a. raising transformers of the same make which take current at 2200 volts and deliver 13,800 volts, two-phase, as well as two Westinghouse water cooled 500 k.v.a. transformers taking current at 2200 volts and delivering 370 volts to operate the rotary converters. In addition there are four oil immersed, air cooled transformers of the same make, size and specifications. The oil circuit breakers operated from the switchboard are mounted from the ceiling of the basement directly under the switchboard. On the transformers are two Westinghouse and one General Electric voltage regulators, the latter being motor operated and having a capacity of 500 kw. On the lighting feeders are four Westinghouse and two General Electric 40 kw. motor operated voltage regulators.

The Masachusetts Street transformer substation on the water front on the southern edge of the business section of the city receives the two 55,000 volt circuits from the White River and Electron power plants. When built in 1902 this substation was intended only as a feeder for the Seattle and Tacoma interurban railway, but it was remodelled in 1904 to receive current from the newly-completed Electron plant. Later, in 1911, when the White River plant was built, it was again remodeled to accommodate the greater capacity. The substation is of brick with a wooden roof, covering a ground space of 50 ft. wide by 80 ft. long. It is divided into two sections, one containing the transformers at the ground level and over these is a room in which are placed the aluminum cell lightning arresters. The transmission lines are brought through roof insulators over the lightning arresters and are led to disconnecting switches, thence into General Electric H-3 oil circuit breakers, then through another set of disconnectors, each line to one of two busses. From each bus is a circuit passing through disconnecting switches only, to a bank of transformers. There is a third bank of transformers protected by an oil circuit breaker and two sets of disconnectors from which are lines to each bus. The bus lines are connected through an oil circuit breaker and two sets of disconnectors.

All of the high tension wiring is insulated, i.e. it is covered with 18/32 in. varnished cambric and then two layers of asbestos flame proof fabric, to prevent as far as possible the danger of fire from short circuits.

Two 10,000 k.v.a. three-phase General Electric water cooled, transformers, lower from 55,000 to 13,800 volts. In addition three 2000 k.v.a. (one being a spare) transformers are Scott connected and deliver two-phase current at 2300 volts.

The five outgoing 13,800 volt circuits, each one feeding a substation which does not receive 55,000 volt current, are 4-0 cambric insulated and pass through bar disconnecting switches, each lead also being provided with a grounding switch.

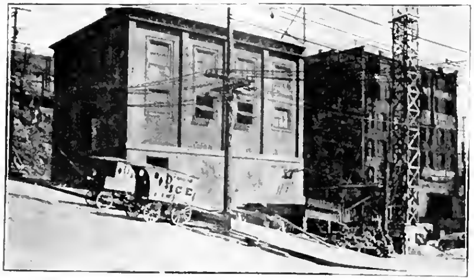
On the main floor are the 13,800 volt and also the 2300 volt oil circuit breakers. These are General Electric, motor operated, mounted in concrete cells, and are equipped with selector disconnecting switches for two bus lines.

In one phase of the 2300 volt circuits is a 240 kw. compensator transformer as well as a pair of 340 kw. induction regulators.

The two-phase 2300 volt circuit supplies light and power in the immediate neighborhood to mills and factories and is also connected with the Post Street steam plant.

An ingenious arrangement for the supply of cooling water is used because of the local supply conditions. The warm return flow from the transformers passes through a set of 1 in. brass tubes into a wood tank. These tubes are immersed in a larger wood tank through which salt water from the Sound is circulated. The fresh water tank is maintained at a predetermined level, any leakage or evaporation being automatically supplied from the city mains. A 10 h.p. induction motor driven centrifugal pump forces the fresh water from the tank through the transformer coils. The salt cooling water is circulated by two 10 h.p. induction motor-driven centrifugal pumps, one being placed close to the intake at the Sound, the other within the substation.

Of the two switchboards the main one is a modern General Electric standard equipment of thirteen blue marble panels. Of these, two control the incoming transmission lines; three the low tension side of the transformer banks; two the 2300 volt tie line feeders;

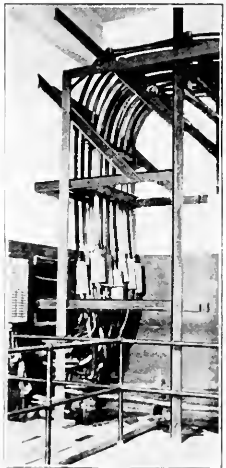


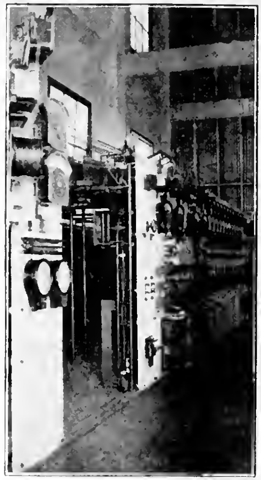
Union Street Substation at Seattle.

one is for graphic recording instruments and five on outgoing 13,800 volt feeders. The second switchboard has three panels, two of which are for local 2300 volt power circuits, while the third is for local lighting.

Union Street is of a late type and modern design. It is of reinforced concrete and was designed to be extended when the service requirement should make this necessary; this extension is now under construction. The finished structure will be 45 ft. wide and 100 ft. long. The structure is heavy, the center columns being designed to carry a load of 740,000 lb. The situation of the building, while practically on the water front at the very center of the city, is on a steep side hill and makes possible, besides the main floor, a basement and a sub-basement. In the sub-basement and in one-half of the basement is to be installed a storage battery of 77 cells similar to the one in operation in the Post Street plant, capable of supplying 2600 kw. for one hour. In the present basement are the oil circuit breakers and their disconnecting switches. These are General Electric, style K-4 on the 2300 volt circuits and K-12 on the 13,800 volt three-phase circuits. The wiring and disconnectors are mounted on iron pipe framing. There are eleven oil circuit-breaker sets mounted in concrete cells. One 340 kw. two-phase General Electric induction regulator is also connected to a 500,000 c.m. 2300 volt circuit coming from the Post Street station.

On the main floor are three motor-generator sets; two of these are of 500 kw. capacity, of the standard type and used by the company. The motor is synchronous, of 710 h.p. The generator delivers direct current at 275 volts into the Edison three-wire system. A 10 kw. 125 volt exciter is mounted on the end of the shaft. The speed of these sets is 720 r.p.m. Two-



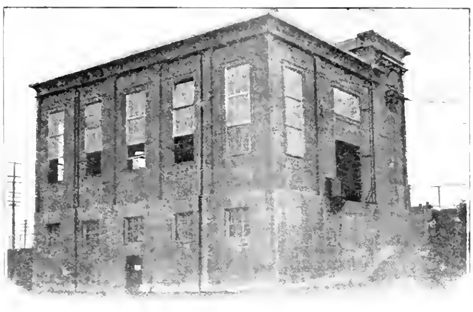


Cable Entrance at Union Street Substation.
Switchboard of Union Street Substation.

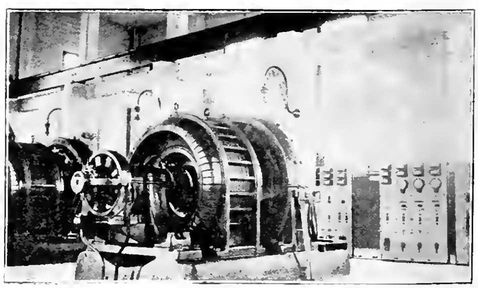
phase current at 2300 volts potential is supplied by two Scott connected, 1000 kw. vertical type, air blast General Electric transformers. The remaining two-bearing motor-generator is of 1000 kw. capacity; the synchronous motor being rated at 1440 h.p. The generator delivers direct current for the Edison three-wire system at 275 volts and is operated at 514 r.p.m. The supply current comes directly from the Massachusetts Street substation at 13,800 volts, three-phase. In the addition, nearing completion, will be placed two 1500 kw. motor-generator sets.

The switchboard is of blue marble in nineteen panels from the General Electric Company. There are six motor-generator control panels, one graphic recording instrument panel, one controlling the 13,800 volt feeder to the 1440 h.p. synchronous motor and one for the transformers; two on feeders to Seventh and Jefferson Street substation and the Massachusetts Street substation respectively, and eight panels feeding Edison three-wire circuits.

North Seattle substation, situated at the northern part of the main commercial section of the city and adjoining one of the car houses, has been recently constructed and is quite similar to the one just described. This building is reinforced concrete, having a main floor and basement. The basement is taken up by the



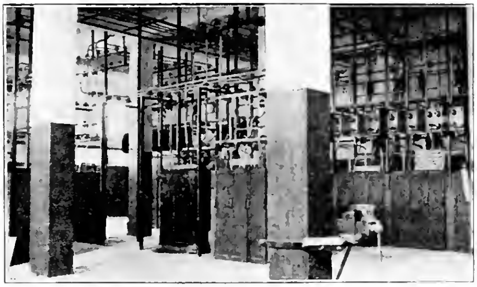
North Seattle Substation.



Interior of North Seattle Substation.

oil switches and disconnectors, the method of mounting and type of apparatus being the same as at Union Street. There is a wire tower at one corner of this building, the incoming circuits being brought down the tower into the basemment. There are two incoming 13,800 volt three-phase circuits, two outgoing 2300 volt two-phase power circuits, three single-phase lighting circuits, two of them being equipped with induction regulators and 8 railway feeders which pass into underground ducts. Of the oil circuit-breakers, there are two on transformer sets, four on both sides of two compensators, one on high voltage motor and four on single-phase circuits. These are operated from an Electric Storage Battery Company's type 7-E storage battery.

On the main floor are one pair of 1000 kw. air blast transformers, which supply the single-phase currents for lighting. There are two motor generator sets of the standard type, the motors being wound for 13,800 volts three-phase.



Basement Switchroom in North Seattle Substation.

The switchboard is of 21 panels of which four control the a.c. and d.c. sides of the motor-generators; one is on the exciters; three on 13,800 volt feeders; four on commercial light and power and eight on railway feeders.

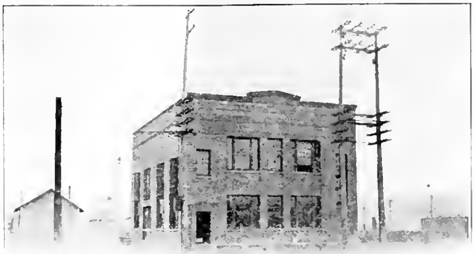
An electrically operated, 20-ton travelling crane completes the equipment of this station.

Ballard substation in the suburb of this name at the northern extremity of Seattle, is comparatively recent but of quite a different arrangement from those just described. The building is of pressed brick. The switch gallery is of reinforced concrete and is supported on one side by the building walls and on the other by three columns of the same material. This leaves one-half of the building an open bay.

On the main floor of this substation are two motor-generator sets, of the adopted standard type, one set of 500 k.w. and the other of 1000 kw. capacity. Space is available for a third set to be installed at some future date. The motors receive three-phase current at 13,800 volts. A pair of General Electric, 1000 kw. air blast transformers, Scott connected, supply a local 2300 volt light and power service. Air for cooling is supplied by a Buffalo Forge Company's blower driven by a 5 h.p. induction motor.

There are three 13,800 volt three-phase lines, one direct from Massachusetts Street substation, one from Fremont substation and one feeding a line to Everett.

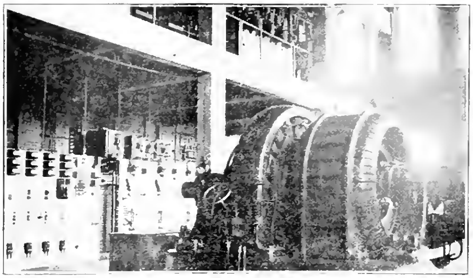
The switchboard is of blue marble and has 18 panels. These are similar in plan to those described, there being five panels on the motor generators, one for a General Electric T. A. regulator, four on 13,800 volt circuits, four on 2300 volt light and power circuits



Ballard Substation.

and five on railway feeders, one of these feeding the Everett interurban railway. The 13,800 incoming circuits as well as those to the a.c. side of the motor-generators are carried in lead covered cable. One type 7-E Chloride storage battery operates the oil circuit breakers. These are General Electric K-4 switches mounted in brick cells, there being seven three-phase sets, one two-phase, 2300 volt and three single-phase, 2300 volt sets. There are two 46 kw. potential regulators on the lighting circuits and a single equipment of General Electric aluminum cell lightning arresters.

Fremont substation, situated in the Fremont addition, just north of Lake Union, is one of the earlier substation and is used for railway supply only. The building is of brick, one-story in height. Originally part of the space was occupied by a storage battery, which has been abandoned. The main part of the station is occupied by two 1000 kw. motor-generator sets of the standard established type, the motors being wound for three-phase current at 13,800 volts. The switchboard is in 17 panels and is similar to the preceding ones with the exception that there are no 2300 volt lighting or power circuits. Three 13,800 volt three-phase lines are brought from the pole, through



Interior of Ballard Substation.

lead-covered cable into the station. Two of these circuits come from the James Street substation and lead into one oil switch through selector switches, the third comes from the Massachusetts substation, via the James Street substation and has its own oil switch. There are therefore two sets of General Elec-

tric K-4 oil circuit-breakers. On the motor-generators and compensators are five sets of K-12 oil circuit breakers. The switches and disconnectors are in a room adjoining the main machine room. This station is also equipped with a type 7-E control storage battery for operating the oil switches and supplying emergency lights.

Fremont Substation.

James Street substation also includes a cable driving plant, operated both by steam engine and motor drive, and a car house. These features will be described under the headings of "Cable stations" and "Car houses."

Interior of Fremont Substation at Seattle.

This is one of the older stations, an inheritance from one of the numerous companies, now part of the system. It is situated in the geographical center of the city a few blocks to the east of the commercial district and on the top of the hill or ridge which divides the water front from Lake Washington. Being on a side hill, the brick building is but one-story in height, but the main operating floor occupies a large basement.

On the main floor is the storage house for cable cars, while adjoining this and on the street level are the switch compartments. The incoming feeder circuits to this substation are all 13,800 volts three-phase. Two of these circuits are brought directly from the Massachusetts Street substation and one circuit from the Georgetown steam generating plant. These circuits are led into the building through three-conductor lead-covered cables. Two outgoing 13,800 volt circuits furnish current to the Fremont substation. The oil circuit breakers, which are General Electric K-12 switches, are mounted in concrete cells in two general rows, in the same manner as described for other substations. On one side are two sets of circuit breakers on transformers, a set on each of the incoming and outgoing lines, and two sets on compensators for starting the a.c. machines. In the other row are the oil circuit breakers for the two-phase 2300 volt outgoing circuits for power and lighting. There are also 13,800 volt, H-3 type circuit breakers as follows: one on the line supplying the Yesler Way cable station motor, one for coupling the bus, and four controlling the circuits to the motor-generators. On this floor are two sets of General Electric aluminum cell lightning arresters, one to each 13,800 volt bus. Finally there are two blowers, which supply cooling air to the transformers, each driven by a 5 h.p. General Electric induction motor.

On the lower floor are the transformers, motor-generators and switchboard in three sections.

The four transformers are 1000 kw. General Electric air blast type and are Scott connected for 13,800 volts, three-phase, on the primary to 2300 volts, two-phase on the secondary side. There are four motor generator sets, all of them being of the standard type previously described, two of them of 500 kw. and two of 1000 kw. capacity.

A railway car air compressor driven by a 5 h.p. direct current motor is used for cleaning purposes.

The switchboard is set in two lines with a section at the end of the room. There are 41 panels and control circuits as follows: two transformer circuits, five 13,800 volt transmission circuits, four 13,800 volt a.c. motors, four on the d.c. side of motor-generators, three on cable motors in three-cable stations, 2300 volts; thirteen 2300 volt feeders and tie lines to Post Street station, eleven d. c. railway feeders, and one railway total panel. These panels are General Electric blue marble on which are mounted a modern equipment of General Electric indicating and Bristol recording instruments.

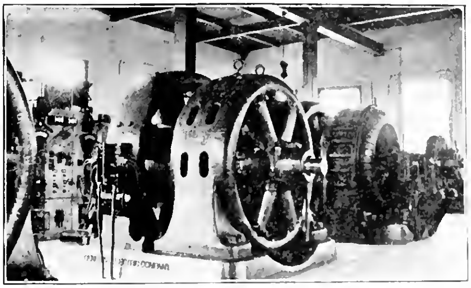
A General Electric potential regulator on a 2300 volt tie line connects with both the Post Street and the Seventh and Jefferson Street stations. This regulator is arranged with disconnecting switches on both sides; behind each disconnector is a tap, the lines from these taps joining through an oil circuit breaker. By this means the circuit may be cut around the regulator, and the latter may be taken out of the circuit. All of the oil circuit breakers are solenoid operated.

West Seattle substation is situated south and west of the main city in the suburb of that name. It is an attractive one-story brick building with one large operating room and wire tower at one corner. Three motor-generator sets are installed with a space for a fourth. The first of these has a capacity of 500 kw. driven by a 700 h.p. 514 r.p.m. 13,800 volt three-phase synchronous motor of the company's standard type The remaining two sets are of 300 kw. each, the motor being induction type, 450 h.p., 2300 volts, two-phase, the generator, 600 volts, 8 pole. These sets are two bearing and operate at 450 r.p. m.

There are two 500 kw. General Electric air blast transformers, Scott connected, 13,800 volts, three-phase to 2300 volts, two-phase. Cooling air is supplied by two Buffalo blowers, each driven by a 2 h.p. induction motor. Three sets of General Electric K-12 solenoid operated oil circuit breakers are mounted in

concrete cells and provided with disconnecting switches mounted on pipe frames.

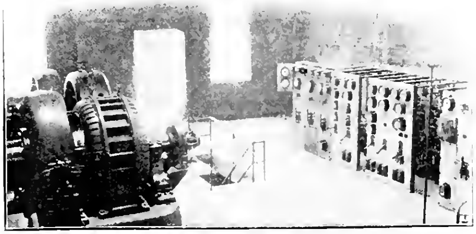
In one corner, adjoining the wire tower, is a set of General Electric aluminum cell, electrolytic lightning arresters.


Motor Generators at West Seattle Substation.

The switchboard, consisting of 10 panels, is of the modern General Electric type, similar to those in other substations. There are 6 panels controlling the a.c. and d.c. sides of the motor-generators and four railway feeder panels.

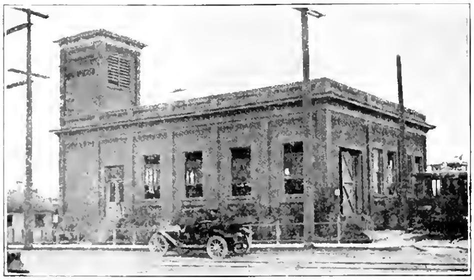
Everett substations. There are two substations in Everett, which until recently have supplied competitive systems. The older substation is part of the Snoqualmie system while the other is comparatively new. They are within a short distance of each other.

The older station is of brick, 20x30 ft., with a corrugated iron addition 20x20 ft. Installed in the main part are three 1000 kw. Westinghouse transformers, one of them being a spare, Scott connected on the primary side for 55,000 volts and on the low tension side 2300 volts two-phase. Above the transformers on a steel frame are three single pole, Pacific Electric Mfg. Co., oil circuit breakers. There are four Westinghouse booster transformers on the outgoing 2300 volt lines. In the addition are five General Electric, 6.6 amperes, 30 kw. arc tubs. These supply the city arc lighting system of 231 lamps. There is a three-panel switchboard in which the first panel controls the transmission line


Interior of Broadway Substation at Everett.

switches, instruments, etc., the second the booster voltage and the a.c. switches for the railway machines in the other substation and the third, the light and power circuits. Poletop disconnecting switches are provided outside of the building.

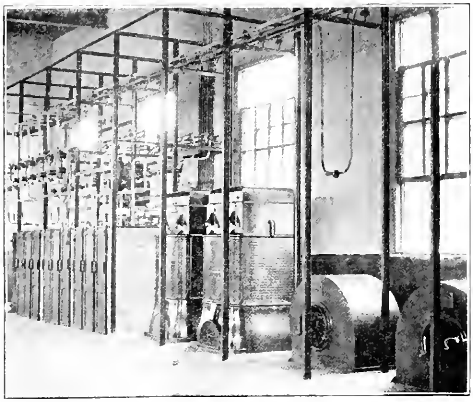
Broadway substation is a substantial one-story reinforced concrete building 60x60 ft., with an addition of greater height, giving a total length of 120 ft. to the building. This addition was built to provide for transformers and high tension switching apparatus,


West Seattle Substation.

but due to a change in plans this has not been installed.

On the main floor of the building are installed two motor-generator sets; one of these has a capacity of 500 kw. and is of the standard type of General Electric apparatus used by the company. The other set has a capacity of 400 kw. driven by a synchronous motor of 450 h.p. at 450 r.p.m. The d.c. exciter is mounted at the end of the shaft in the conventional manner.

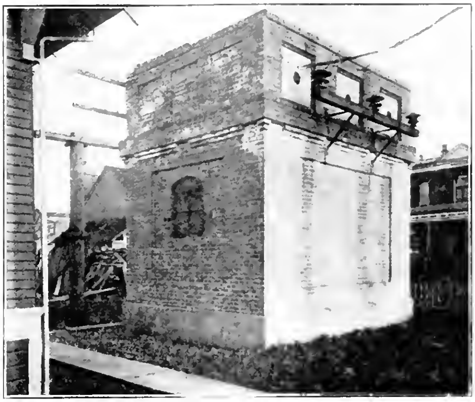
The switchboard consists of twenty panels. There are five 2300 volt two-phase circuits, including a tie line between the stations; one totaling d.c. railway panel; one Tirrill regulator panel, four controlling the a.c. and d.c. sides of the motor-generators; one each for d.c. and a.c. motors; one a.c. compensator; one d.c. power; one on railway feeders; two controlling arc circuits and water works pump motors.


Switches and Transformers at West Seattle Substation.

In the basement are the pumps for the city water works system. There are two Worthington pumps of 3,000,000 and 2,000,000 gal. capacity respectively. The first is a two-stage pump delivering water at a pressure of 90 lb. to the square in. and driven by a 250 h.p. 2300

volt, variable speed General Electric induction motor. The other pump is driven by a 150 h.p. motor of similar type and specification.

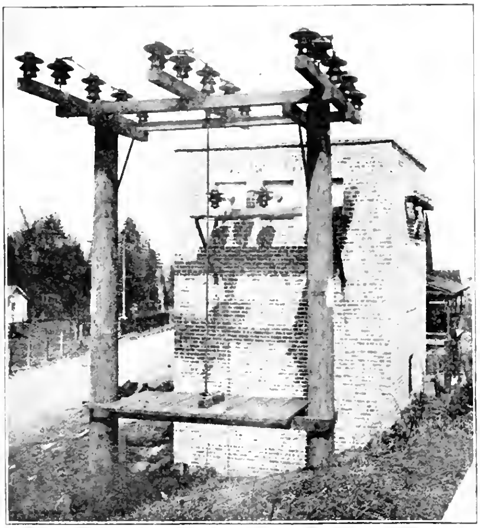
The pumps deliver water either directly into the city mains or into two cement reservoirs, the older



Auburn Substation.

having a capacity of 3,000,000 gal., while the latter which has been recently completed at a cost of $100,000, has a capacity of 10,000,000 gal.

Ordinarily the total supply of power for the city and the railway system is supplied from these substations, they are however tied in with the steam generating plant which is held as a standby. This plant is described under "Steam generating plants."

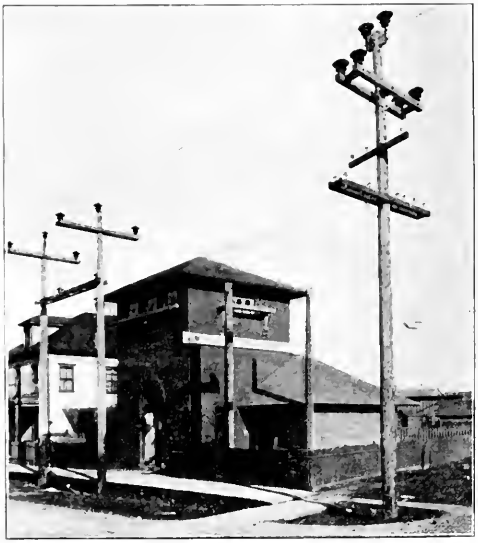


Issaquah Substation.

Bellingham substation. The main substation is integral with the auxiliary steam plant which is described under the head of "Steam generating plants." The three 500 kw. lowering transformers in this station are connected to the transmission line from the Nooksack Falls power plant and are similar to the raising transformers. They will be changed during the coming summer when the transmission is changed for 55,000 volt operation. A second substation at South Bellingham is at the gas works. This substation contains three 100 kw. Stanley oil immersed, air cooled transformers, delta connected for 38,000 volts primary and 2300 volts secondary, the distribution being single-phase for lighting and three-phase for power.

Snohomish substation. This substation receives current at 55,000 volts from the Snoqualmie-Everett transmission line. The building is of brick, the transformers are owned by the local gas company, the building and switches, by the power company.

Issaquah, Auburn and Monroe substations. These substations are on the Snoqualmie-Renton, Snoqualmie-Tacoma and Snoqualmie-Everett lines, respectively. They are of brick 20 ft. x 15 ft., with concrete roof, the former and latter contain one and the Auburn



Monroe Substation.

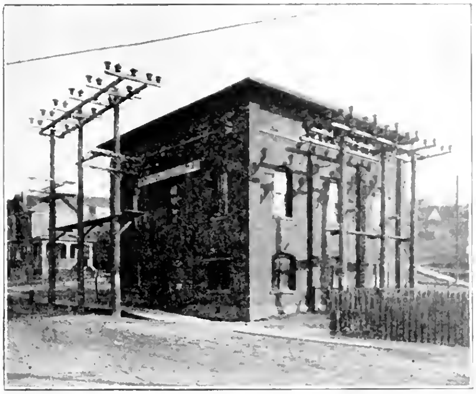
two, Westinghouse oil immersed, air cooled 100 kw. transformers, 55,000 to 2300 volts, in the latter case Scott connected for two-phase distribution. The circuit from one transmission line, which is sectionalized at these points with pole-top disconnecting switches, is brought into the buildings through tube insulators inserted in glass windows to Pacific Electric oil circuit breakers. These switches are mounted above the transformers on "I" beams.

The switchboards are a single panel of Westinghouse instruments mounted on white marble.

Kent and Milton substations. These substations were designed primarily to supply power to the interurban railway between Seattle and Tacoma, but each now supplies also a local light and power service. They are similar in design and arrangement and vary only slightly in equipment. The buildings are of brick, equal to two stories in height, with a one-story addition in the rear containing the storage battery. These

substations receive 55,000 volt three-phase current from what is known as the "Electron line," which is built along the railway right of way, but in each case a circuit from but one transmission circuit is brought into the building. In the case of the Kent substation, the main line is sectionalized with two sets of pole-top disconnecting switches and two leads are taken off, each from the same line outside of the disconnectors. These circuits are brought into the building through 24 in. tiles fitted with glass panes. One of these, after passing through a disconnector, taps into the bus line, while the other passes through a General Electric H-3 oil switch mounted in brick cells, and which is protected by two sets of disconnectors. From the bus a circuit is carried, through an oil switch and two multiple sets of disconnecting switches to two sets of transformers. The storage battery consists of 288 "Chloride" cells, being the same in both stations.

At Kent are two pairs of transformers for power and a fifth for local lighting. These are General Electric oil immersed and air cooled, 200 kw. 55,000/2300



Renton Switching Station.

volts and are Scott connected for two-phase secondaries. At Milton there is at present but one pair of similar transformers, although they are water-cooled. In both station there are two 300 kw. motor-generator sets. These sets are two bearing with a 450 h.p. two-phase induction motor and 600 volt 8-pole d.c. generator and operate at 450 r.p.m.

Each station also contains a booster set for charging the battery. This consists of a 53 h.p., 4-pole, d.c. motor with a voltage variation of 600-700 volts and speed from 600-660 r.p.m., driving a 6-pole generator, designed to deliver from 60-120 volts.

The switchboard has 9 panels (at Kent there is an additional railway feeder panel) as follows: 2 for induction motors; 3 d.c. generator panels; 1 d.c. total panel; 2 railway feeders; 1 local lighting.

General electric carbon resistance lightning arresters complete the equipment of each building.

Renton substation. This is one of the most important of the substations as it is a sectionalizing point of the two main branches from Snoqualmie Falls. The building is of brick, two stories in height, a new and larger building is soon to replace the present one and will contain an operating room and a standard motor-generator set. On the second floor are the oil switches, while on the first floor is a set of transformers supplying local power to a nearby col-

Milton Substation.

liery and a switchboard for local service. The transformers are three 500 kw. Westinghouse air cooled, oil immersed, in corrugated sheet iron cases. They are delta connected 55,000 to 2300 volts. A series arc service on two lines, 6.6 amperes, is operated from this point.

Two main 55,000 volt circuits enter the station from Snoqualmie Falls, while four circuits leave the station, two for Seattle and two for Tacoma. Of the latter, one is looped into the new White River generating station. All lines are equipped outside of the building with poletop disconnecting switches. Entrance is made through 42 in. x 3 in. porcelain tubes, mounted in marble slabs which are in turn inserted in window openings. All oil circuit breakers are protected with disconnectors manufactured by the company.

There are two sets of General Electric K-10 circuit breakers on the Snoqualmie lines; 1 set for connecting bus lines; 1 set Pacific Electric Mfg. Co. on the local transformer circuit; and 1 set General Electric K-15 circuit breakers on both Tacoma lines.

Puyallup substation. This substation is supplied from the "Electron" transmission at 55,000 volts. It is a brick building and contains two 100 kw. General

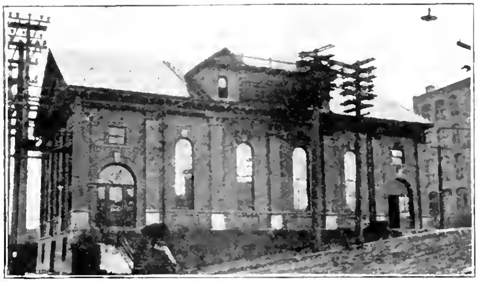
Kent Substation.

Electric transformers, Scott connected to deliver 2300 volts, two-phase. Besides supplying the town, a service is extended to the town of Sumner.

Tacoma.

In this city are four substations. One connected with the Snoqualmie system is purely a substation without a steam auxiliary. Station "A," the main steam power plant and now used as an auxiliary, con-

tains the remainder of the high tension substation apparatus. Station "B," at Fern Hill, a suburb, is a railway substation and steam auxiliary. Station "C" is a transformer station for the Northern Pacific Railway shops at South Tacoma.



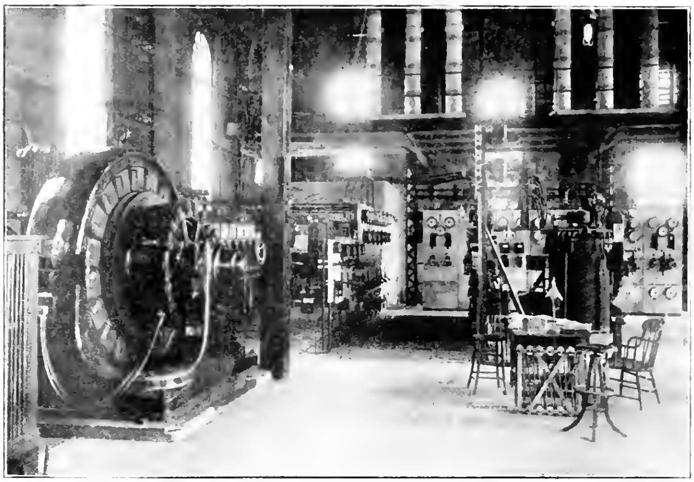
Snoqualmie Substation at Tacoma.

Snoqualmie substation. This, like the substation in Seattle, is a large brick building with a considerable attempt at architectural adornment. Since its erection it has gone through most of the changes incident to the various epochs in the development of long distance transmission. Upon the main floor are the switchboards, part of the transformers, a rotary converter and offices. On the basement floor are transformers, regulators and storage rooms. Upon a gallery are the high tension circuit breakers and lightning arresters. Two transmission circuits from Snoqualmie Falls, after passing through poletop disconnectors, enter through porcelain tubes. There are three sets of Pacific Electric oil circuit breakers, hand-operated from the switchboard and one set of General Electric K-15 circuit breakers operated in a similar manner. These switches are on both the incoming lines and transformer sets. Four 2500 k.v.a. water cooled, Scott connected, Westinghouse transformers, 55,000 to 2300 volts are placed under the switch gallery, but in the basement. Three 1000 k.v.a. 55,000 to 27,600 volt, Westinghouse oil immersed air cooled transformers, delta connected on both sides, supply current to the copper smelter at old Tacoma. There is one 500 kw. Westinghouse potential regulator for the city distribution lines. The remainder of the apparatus in the basement consisting of eleven boosting series transformers and 18 a.c. arc light tubs, are part of the municipal system of the city which receives its current supply from this substation.

On the main floor a 500 kw. Westinghouse rotary converter receives its a.c. current from two 300 kw. Westinghouse air cooled and oil immersed transformers, having a primary winding for 2300 and secondary for 390 volts.

A 10 ton, triplex block, hand operated travelling crane, having a span of 15 ft., runs the length of the building, being supported by the wall on one side and a rail placed on columns on the other. Westinghouse aluminum cell lightning arresters placed in the gallery for the incoming lines completes the equipment of this station.

The three remaining substations in Tacoma will be described under the heading of "Steam generating plants."

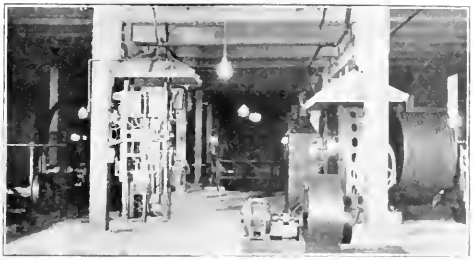


Interior of Snoqualmie Substation at Tacoma.

Bellingham-Skagit Railway Substations. The two substations for this railway system when it is completed in the summer of the present year, will be situated at Clayton Bay and at Burlington. These substations will be concrete structures and each will be equipped with one 500 kw. standard motor-generator set operating at 514 r.p.m. and will be supplied with suitable transformers wound for 55,000 to 2300 volts. A transmission line feeding these stations will be of aluminum equivalent to No. 1 copper. Three-phase distribution systems at Burlington and Sedro-Wooley for lighting and power will get current from this circuit.

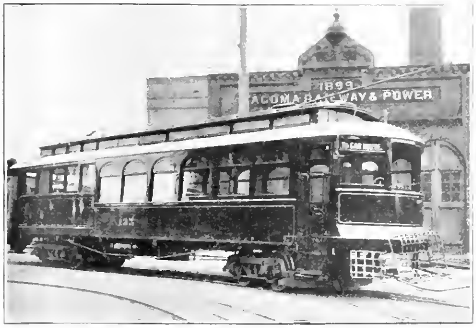
Cable Driving Plants. Of the four cable driving plants included in this system three are in Seattle and the fourth in Tacoma. The machinery for these plants is conventional and quite similar. Until re-

cently they have, with one exception, been driven by steam engines and these remain in service, to be used in the event of failure of the driving motors. All of the driving motors are General Electric 2300 volt, two-phase, variable speed rheostat control, induction type, of 300 h.p. capacity with the exception of the Tacoma installation. This last named is to be eventually replaced with a motor of 200 h.p.


Madison Street Cable Driving Plant at Seattle.

In Seattle, the cable lines are approximately parallel and operate from the main business sections in an easterly direction over the hill between the water front and Lake Washington. The James Street line is operated from the plant in the James Street substation, the Madison Street line from a driving plant located in the basement of the Madison Street car house. The Yesler Way line terminates on the shore of Lake Washington at the steam driving plant and car house originally built for this line. In this plant are three return tubular boilers and two Corliss engines of 250 h.p. and 200 h.p. respectively. The steam plant in this station will be eventually dismantled.

In Tacoma the cable system is quite similarly situated to that of Seattle. It is now driven by a 100 h.p., 600 r.p.m., 2300 volt, two-phase General Electric induction motor. There is also a 200 h.p. Corliss engine which is used in starting the cable.



Minneapolis Type Type Car at Tacoma.

The towns of Maple Falls and Glacier are lighted, a single 50 kw. transformer being connected to one wire of the transmission, the other side being led to ground. A branch line 5 miles long supplies power to a mill. At this point is a substation containing three 100 kw. transformers. Westinghouse low equivalent lightning arresters are installed at either end of the transmissoin.

Railway Systems.


On the Seattle-Everett Interurban.

THIS company operates seven railway systems, now more or less interconnected. These comprise the Seattle city lines, the Tacoma city lines, the interurban between Seattle and Tacoma, the interurban between Seattle and Everett and the Everett city system, and the Bellingham and Skagit interurban system, and the Bellingham city system.

Car Equipment.

The car equipment of the first two systems is quite similar, the so-called "Minneapolis" type city car being much favored. This car is single ended. About two thirds of the car from the front is closed, the remainder open, with blinds for inclement weather. The rear platform is large and is open. All cars are "Pay on entering," and the conductor is invariably stationed on the rear platform within a pipe frame enclosure. All cash fares are paid into a coin box. In both cities a number of single truck cars are still in use, these being provided with gates and the P. O. E. feature. In both cities a number of double end cars are in use. These are entirely closed. Entrance is at the rear but exit is both front and rear. The gates in both this and the single truck type are operated by a lever movement from the motorman. In the "Minneapolis" type cars both exit and entrance gates, each consisting of two steel wicket gates opening outward, are operated by the conductor. A new type of double truck, double end steel car has been adopted for use in Seattle.

As before stated there are three cable lines in Seattle and one in Tacoma. These lines are 3 ft. 6 in., narrow gauge. The cars are double truck and will seat about 32 people. A flat jaw grip is used operated by a lever. Both wheel and track brakes are used, the


New Type Steel P. O. E. Car.

former operated by a lever and the latter by a foot lever.

The standard color adopted for all cars is a dark olive green. This is a recent change from orange which has been heretofore used and all cars will be eventually painted the new color.

The cars in use on the Seattle-Tacoma interurban are of two general types, differing in the details of the

car body only. On local trains, two cars are generally used, the forward car having a baggage compartment, the rest of the car being a smoker. The other car is a standard passenger coach. On the expresses, but one car is ordinarily used; this is divided into three sections, a smoker, coach and parlor car. The seats in the coaches and smokers are transverse with cane backs and bottoms, in the parlor car section are cane chairs with velvet cushions. The car equipments are four motor, General Electric multiple unit control.

On the Seattle-Everett system six single cars are operated. These were furnished by the Niles Car Company and are 52 ft. long, have a seating capacity of 56 and weigh 40 tons. The equipment is four 75 h.p. No. 73 General Electric motors (without interpoles), General Electric multiple unit control and Westinghouse air brakes. The arc headlights are arranged with a three-point switch which gives full light, dim light for use in the city streets, and off. The cars have two compartments and are handsomely finished in mahogany.

On the Everett city system there are 17 cars, six of which are single truck.

Cars for the Bellingham-Skagit line will have Westinghouse four motor equipments with multiple-unit pneumatic control.

Both interurban and city lines do freight business. On the former regular trains are run at night; on the latter building and other materials are distributed about the city.

Where there are sections of single track which diverge into double track and vice versa, a suspended signal switch is used. This switch, which is built by the company, hangs directly over the track and from it are dropped two ropes to a height such that the motorman in his car may reach up, grasping a rope, thereby throwing the switch. In series with the switch is a group of five lamps placed at the other end of the single track section. Upon coming on to the single track the switch is thrown to light the lamps at the other end, thus warning a car from the opposite direction from going on to the single track. Upon reaching the double track again the switch at the other end turns the lights off and thus the track is cleared.

Interurban Depot and Cars at Everett.

Tacoma City Lines.

In Tacoma the city lines are quite similar to those in Seattle, there being about 125 miles of equivalent single track. There are extensions to the suburbs of Spanaway and South Tacoma and to Puyallup, Old Tacoma and Steilacoom.

Track and Roadbed Systems.

In Seattle are 33 city lines, including three cable routes. A standard city construction is in use where the tracks are in pavement. Trolleys are, as a rule, No. 00 round copper and practically all standard.

Where it is possible, in the commercial districts, span wires are fastened to eye-bolts placed in building walls, otherwise support is had from tubular iron poles. In the outlying districts wooden poles are used. Feeder wires in some of the downtown districts are run underground from the substation and are carried up the side of the building to the span connecting thereto. At other points feeders are carried on four-pin arms mounted on the iron poles. In the residence and suburban districts the feeders are carried on Light and Power Department poles, or those jointly owned

SPECIFICATIONS OF CARS IN SEATTLE

Style of car	Class	Capacity	Inside finish	Trucks Make Style	Wheels Material Diam.	Motors No. Style	Controllers	Gear ratio	Brake	Fenders	Weight	Built by
Single end, double truck...	600	56	Cherry	S.M.T., C60	steel, 34″	4, GE-80	GE-K28	15-71	Nat. air Pea. hand	S. E. Co.	54,800 lb.	St. Louis Car Co.
Double end, double truck...	500	48	Cherry	Brill, 27G	steel, 34″	4, GE-80	K28 & K6	15-71	Chr. air Pea. hand	S. E. Co.	46,440 lb.	St. Louis Car Co. & Brill.
Double end, single truck...	100	26	Oak	J. & S. Brill	cast, 33″	2, GE-58	GE-K10	17-67	hand	S. E. Co.	18,400 lb.	Jackson & Sharpe & Brill.
Double end, cable, double truck...	...	34	Ash Span. cedar	Hammonds	cast, spoke 22″	1 grip	2 ends	....	wheel track	S. E. Co.	12,000 lb.	Hammond.
Freight, double truck...	400	40,000 lb.	fir	Brill, 27G	cast, 33″	4, GE-58	GE-K6	17-67	air hand	S. E. Co.	....	Seattle Electric Co.
Wrecker, box car, single truck...	400	12,000 lb.	..	Brill, 21E	cast, 33″	2, GE-1200	GE-K2	17-67	hand	S. E. Co.	....	Seattle Electric Co.
Line box car, single truck...	400	....	fir	Peckham	cast, 33″	2, GE-1000	GE-K10	17-67	hand	S. E. Co.	....	Seattle Electric Co.
Freight, "Totem," double truck...	400	40,000 lb.	fir	S.M.T., C60	steel, 33″	4, GE-57	GE-K14	17-71	straight auto hand	S. E. Co. S. M.	78,700 lb.	Seattle Electric Co.

S. M. T. stands for Standard Motor Truck Co.
S. E. Co. for Seattle Electric Co.

Number of cars:

Passenger Motor Cars	409
U. S. Mail Motor Cars	2
Passenger Cable Cars	55
Freight and Construction Motor Cars	26
Freight and Construction Flat Cars	50

with other companies. There is but a small amount of bradset suspension and that in an outlying district.

Trouble on trolley lines is cared for by three line cars, and a two-horse railway tower wagon is held in reserve.

Track in Seattle:

Number of routes	33
Miles of equivalent single track	198.91
Mileage in paved streets	102.55
Mileage in unpaved streets	96.36
Miles of trestle	14.67
Number, Chetham electric switches	39

Type of rails used in Seattle:

Paved streets, present standard, 80 lb. T, Lorain, Section 335.
Paved streets, 72 lb. T, Lorain, Section 331.
Paved streets, 62 lb. T, Pennsylvania, Section 242.
Paved streets, guard rail (special work), 113 lb., Pennsylvania, Section 234.
Unpaved streets, 60 lb., A. S. C. E. Standard.
Cable lines, 40 lb.
Standard rail joint, Continuous.

The Seattle and Tacoma Interurban has a length of about 34 miles, although in both cities the cars run over the local lines to the city limits, so that the actual length is somewhat greater than this.

This line after passing through Georgetown takes a southerly course and serves Renton Junction, Kent, Auburn, Milton and smaller stations. At Kent and Auburn are depots, the former being of some pretention. The depots and shelter stations are frame structures and vary in design and finish.

The roadbed has a gravel ballast, the ties being of native timber. The rails are 72 lb. Lorain, section No. 331. The system operates entirely third-electric rail between the city limits. This rail is heavy, being 100 lb. steel and is supported on a cast iron, fibre insulated track insulator. There are numerous sidings, as the road is single track for part of the distance. From Tacoma to Auburn is single track, from there to Thomas it is double tracked, where it becomes again single and continues thus to Renton Junction. From this latter point into Seattle it is double tracked. The total equivalent single track is about 60 miles.

At road crossings a ringing signal is used. This is supplied by the National Electric Manufacturing Company. It is operated from a circuit which is closed when the car or train passes a short section of electric rail placed on the opposite side of the track from the third rail. The bell continues to ring until contact is again made with another similarly placed rail on the further side of the bell. At the Tacoma end of this system is a section of catenary trolley, otherwise all trolley is of ordinary type.

Electric Signal Rail on Seattle-Tacoma Line.

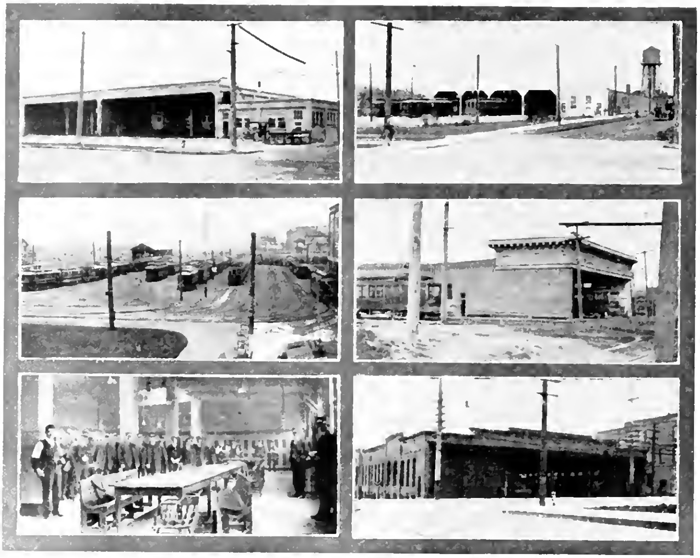
The Seattle and Everett Interurban Railway, which was formerly known as the Pacific Northwest Traction Company, has recently entered the Stone & Webster consolidation. The system, commencing at the northern limit of Seattle, runs in a northerly direction to the city of Everett. There is one branch line two miles long to the Seattle Country Club and this line is operated by that institution, although the cars and operators are supplied by the railway company. Cars of this system after arriving at Seattle are run over the city lines to a station in the business center. At the Everett end is a substantial brick depot containing waiting rooms and tickets offices and in the second story are the executive offices of the road. Two tracks are carried into the station, an umbrella shed being provided for the protection of passengers while entering and leaving cars. The road is picturesque, passing through a dense forest of firs which tower to a great height on both sides of the right of way and give the impression of traveling through a splendid avenue.

Building the Belingham-Skagit Line Along Puget Sound.

When first built this line extended only to Howell Lake, 12 miles from the city limits. It was built with 60 lb. rails and of not as good construction as was later adopted. When the line was extended to Everett the old line was straightened and given a better grade. The line now is well ballasted with gravel. The ties are of hewn native timber. The rails on the old section are 60 lb., but on the new section from Howell Lake to Everett are 70 lb. standard A. S. C. E. section, with continuous joints. Stub cattle guards are used. This is a local device and consists of several rows of 2 in. x 6 in. planks cut in short sections and placed on end so that they incline to the horizontal about 60 degrees. Short sidings are frequent and at Howell Lake is a corrugated iron substation equipped with one standard 500 kw. synchronous motor generator set. A 13,800 volt, three-phase aluminum circuit equivalent to No. 00 copper is carried at the top of the trolley poles on one side to this station. This line comes from the substation at Ballard. The poles on one side are 45 ft. long and have two arms, the upper carrying the transmission circuit, while the lower arm, 10 ft. below, carries a telephone circuit and a 750,000 c.m. aluminum trolley feeder. On the other side the poles are 25 ft. long and are given a heavy rake. The trolley wire is No. 00 copper.

A novel road crossing signal is installed on this line. It consists of an illuminated sign with the words, "Stop, car coming." This is lighted on the approach of a car by twelve 16 c.p. incandescent lamps, wired on two circuits from the trolley. In operation contact is made by means of an insulated rail section from which two wires are brought to the shelter station at the crossing. At this point is a 22-cell storage battery which receives a constant charge through a series of four c.p. lamps. There are two 4-point switches operated by solenoids. The action of the car closes a circuit which actuates the first solenoid, the second, acting as a relay, closes the light circuit and at the same time connects the battery in series with the lights. By this means the battery is kept fully charged.

The length of the line from the Seattle city limits to Everett is 23 miles. From the Seattle depot to the

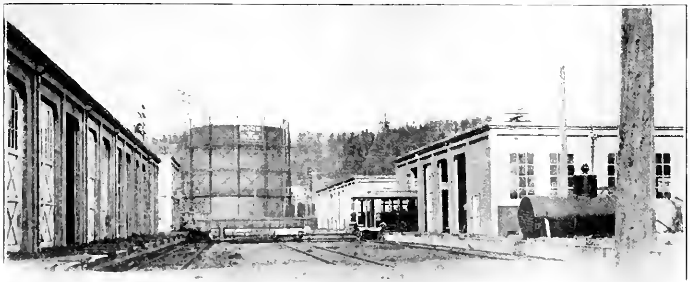


SEATTLE CAR HOUSES.

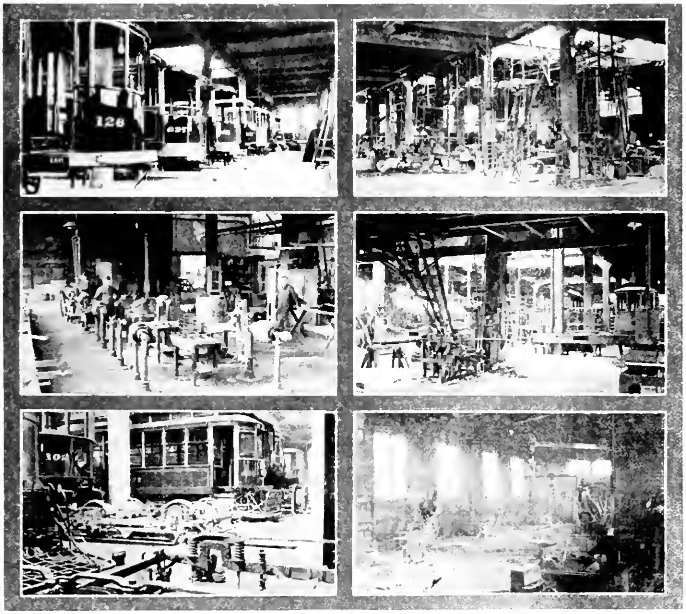
North Seattle. Tenth and Jefferson Streets, Seattle.
Storage Yard at North Seattle. Fremont.
Men's Club Room at North Seattle. Tacoma.

Yesler Way Cable Driving Plant.

Madison Street Carhouse and Cable Plant.



Georgetown Carshops.



INTERIOR VIEWS GEORGETOWN CAR SHOPS.

Paint Shop.	Machine Shop.
Armature Shop.	Carpenter Shop.
Assembly Department.	Forge Shop.

city limits is about 6 miles. Freight is handled at night, there being two regular trains each way. Lumber products are handled principally.

Bellingham-Skagit Railway is now under construction. It is to be modern and of high class construction, extending 27.5 miles from Bellingham to Burlington and Mt. Vernon. From Burlington there is to be a 5-mile branch line to Sedro-Wooley. A catenary trolley construction is to be used, supported on brackets from a single line of 45 ft. poles.

A three-phase, 55,000 volt transmission line of aluminum, equivalent to No. 1 copper, will be carried at the top of the poles for the supply of the two substations at Clayton Bay and Burlington and this transmission line will be continued from Burlington a distance of 28 miles to Concrete, to supply power to Portland cement mills, where 4000 kw. transformer capacity is to be installed.

The Bellingham city railway has 23.9 miles of equivalent single track. Ordinary span trolley, No. 00 round copper is used. There are about 50 cars operated of which 25 are motor cars for passenger service, the remaining are miscellaneous, trailers, freight, repair cars, etc.

Car Houses and Car Shops.

The car houses are at various points on the system suitable to the requirements of operation. Aside from storage or washing and cleaning, very little, if any, repair work is done, this being left for the shops at Georgetown and Tacoma.

As the car houses are natural points where the car operators congregate, the company has considered

the proper organization of social pursuits and comforts as of prime importance towards efficiency in operation and conducive to a close friendly feeling which it is the policy of the company to maintain toward all employees at all times. All of the principal car houses are equipped with lounging and club rooms, provided with comfortable arrangements for lunching and bathing. Each club room is equipped with lockers for every man whose run may bring him to the car house and a billiard and pool table. Bulletin boards in the club rooms are so placed that communications and other directions may be posted for careful perusal by the men and communication between headquarters and operators is easily maintained and understood. A school of instruction for new men is also maintained.

In all of the car houses are track pits, and these, as a rule, are under nearly all of the tracks in the house. The Shuffleton system of cast iron track mounting is used in all pits. This consists of an "A"-shaped cast iron yoke every few feet under the rail, the latter being supported on a heavy timber. This mounting makes practically a clear space under the entire track system.

A novel experimental car washing system designed at the Georgetown shops consists of a revolving brush 8 ft. long and 24 in. diameter. It stands vertically and is moved, revolving, along the side of the car by suitable mechanism. Water is delivered from the center of the brush.

The car houses, their capacity, material of building, etc., are given in the following table:

* Sprinkler system. † Shop. ‡ Transfer table.

Name.	Car cap.	Wash rack. cap.	No. tracks.	Crane.	Pit tracks.	Bld.
Seattle						
Tenth and Jefferson*‡	40	2 cars	8	25 ton	7	frame
do storage yard ..	30	......	7	......	..	......
North Seattle†	48	2 cars	12	......	12	re-con
do storage yard ..	128	......	16	......	..	......
Fremont	56	2 cars	6	......	4	brick
do storage yard ..	40	......	8	......	..	......
James Street Cable	6	1 car	4	......	..	brick
Madison Street Cable* ..	12	1 car	4	......	..	frame
Yesler Way..........	48	1 car	11	......	..	frame
Kent Interurban†‡	15	......	3	......	3	frame
Tacoma, Shops‡..........	30	2 cars	6	......	4	brick
do storage yard....						

The main shops of the system are at Georgetown, a suburb at the southernmost limit of Seattle. These shops are arranged on both sides of a straight pit, throughout the length of which operates an electrically driven transfer table. The buildings, with the exception of the forge and brass founding houses, which are of corrugated iron, are of reinforced concrete panel and column construction which present a neat and substantial appearance. On the north side are the paint shop, store rooms and offices and wheel grinding apparatus. The paint shop has a capacity for 20 large or 30 mixed cars and is well equipped for good work. The store room has a large capacity and a careful system of accounts and segregation of the myriad supplies is practiced here. The wheel grinding machine, which is used for resurfacing car wheels, is an apparatus in which there is an adjustable mandrel carrying two emery wheels, which are rapidly revolved by means of a belt drive actuated by a 15 h.p. induction motor.

To the south of the transfer table are the carpenter, machine and armature shops, forge shop and brass foundry. The carpenter shop has a capacity for about 20 cars and is equipped with the various wood-working machines necessary for modern equipment. The armature shop, which occupies part of the machine shop building, is always a busy spot in a railway system and requires a high class of work. In front of this is the sheet metal, air-brake and controller shop where specialized skill is also required. The machine shop has a capacity for about 15 cars. In the equipment are 1 car-wheel lathe, 6 machine lathes, 2 shaping machines and 3 planing machines. These are all motor driven. In the rear of the machine shop is the forge shop. This contains 9 forges, 1 power hammer, 1 babbitt heating furnace, emery grinders, etc.

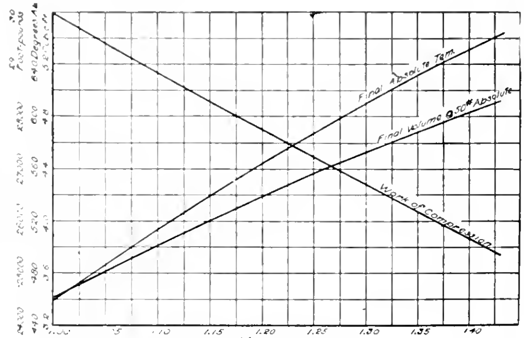
These shops are prepared to build cars if necessary, but are used principally for repair work.

The Tacoma shops at the central station and car house are equipped for repairing the cars of the local system, but not to such a scale or extent as may be done at the Georgetown shops.

WORK OF COMPRESSION OF ONE POUND OF AIR.

BY F. E. PERNOT.

In the operation of the air compressor it often becomes necessary to introduce a factor denoting the work of compression of one pound of air. This work varies, as is generally known, according to the exponential law of compression under which the air is forced. The following data is useful for problems of this nature involving the compression of air according to any exponential law between isothermal and adiabatic compression.



Compression of One Pound of Air.
From 14.7 lb. abs. along curve $P V^n = K$.

Compression from 14.7 lb. sq. in. to pressure of 50 lb. per sq. in. (absolute). Initial temperature = 0.00 deg. F. = 459.6 deg. F. (absolute.)

Compression along curves $p v^n = K$.

R for air = 53.37.

$p v = R T$ $p_1 = 14.7$ $T_1 = 459.6$ $v_1 = 11.59$ cu. ft.

$v_2 = v_1 \ (p_1 / p_2)^{\frac{1}{n}}$ $p_2 = 50.00$

$T_2 = p_2 v_2 / R$

W = work of compression as given by indicator card.

$W = p_1 v_1 \log_e \ (v_2 / v_1)$ for particular case of $n = 1.00$

$W = \dfrac{p_2 v_2}{n - 1} \left(1 - (v_2 / v_1)^{n-1}\right)$ for other values of n.

W given in foot-pounds.

Tabulating.

	Values of n.	T_2 abs.	T_2 F.	v_2 cu. ft.	W ft. lbs.
Isot.	1.00	459.6	00.00	3.4065	30,031
	1.10	513.7	54.10	3.8078	28,875
	1.20	563.6	104.00	4.1779	27,759
	1.30	610.2	150.60	4.5228	26,693
	1.40	652.1	192.50	4.8333	25,676
Adiab.	1.406	654.5	194.90	4.8514	25,612

The above results are shown on the curve.

WESTERN LAWS OF ELECTRICITY AND WATER

COURT ASSISTANCE IN ESTABLISHING JUST WATER RIGHT ADJUDICATION.

BY A. E. CHANDLER.

Previous papers of this series have shown the distressing situation in quieting title to water right benefits in California and other western states. Mention has been made of the fact that relief is largely to be found, not in legislation, but in broad minded decisions of the courts. It will be interesting and at the same time instructive before proceeding with further water-right discussion, to relate at this time the details of a remarkable water-right decision (Hough vs. Porter, Ore., 98 Pac. Rep. 1083) allusion to which has been made in previous papers.

In the little-known region of South Central Oregon is a short mountain stream caller Silver Creek, which empties into a lake of the same name. Although its summer flow is but slightly in excess of ten cubic feet per second, Silver Creek is destined to be one of the best known mountain streams of Oregon, on account of an opinion of the Supreme Court of Oregon, dated January 5, 1909, in the case of Hough vs. Porter.

This suit was originally instituted in the Circuit Court of Lake County on April 14, 1900. There were originally two parties plaintiff and one party defendant. The judge of the Circuit Court, believing that the controversy could not be properly determined without the presence of other parties, ordered that all those using the water of Silver Creek should appear as parties to the suit.

The case finally reached the Supreme Court and an opinion was handed down in May, 1908 (Hough vs. Porter, 95 Pac. Rep. 732). At the close of this opinion it is stated that the records disclose that none of the lands were settled upon till 1878, which is subsequent to the passage of the Congressional Desert Land Act. The court further stated that "it is a serious question whether this Act does not abolish the common law rule relative to the doctrine of riparian rights, so far as its interpretation has been applied to irrigation of lands to which title has been acquired since that Act became a law." The court therefore concluded to continue the case for further argument, in accordance with which order further argument was submitted and the final opinion fiiled, as stated above, on January 5, 1909 (98 Pac. 1083).

The Desert Land Act was passed on March 3, 1877, and provides in brief that any person possessing the necessary qualifications may secure "a tract of desert land not exceeding one section, by conducting water upon the same, within the period of three years" after filing his declaration. Among the provisos included in the Act is the following: "And all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers and other sources of water supply upon the public lands, and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining and manufacturing purposes, subject to existing rights." This clause of the Act is the one upon which the court desired a more extended argument.

In its opinion the court makes an able and extended argument on the provisions of a number of Congressional Acts, beginning with the Act of 1866, protecting vested rights which had been "recognized and acknowledged by local customs, laws and the decisions of the courts." It concludes as follows: "Construed, then, with the Act of 1866 and other provisions of the Act of 1877, we are of the opinion that all lands settled upon after the date of the latter Act were accepted with the implied understanding that (except as hereinafter stated) the first to appropriate and use the water for the purposes specified in the Act should have the superior right thereto. So far as we are able to determine, the question, as here presented, has not heretofore been squarely before any of the courts."

Following the above conclusion the court makes an examination of the many cases decided, by both the State and Federal Courts, in which the Desert Land Act of 1877 was considered, and decides that they are in harmony with the above conclusion.

The opinion further states: "But the effect of the language of the Act that 'there shall remain and be held free for the appropriation and use of the public for irrigation,' etc., we think, while constituting words of reservation and dedication, limits the rights thereunder to the deprivation of the riparian lands of the water only in so far as it may be claimed by the riparians for the purposes there enumerated. One of the rights inseparable from the land has always been that the owner of such land was entitled to an adequate supply of water flowing over it for domestic use, together with sufficient for the domestic animals necessary for the proper subsistence and maintenance of the landed proprietor and his family." The above statement is followed by a detailed argument in which the court attempts to justify its position that the mere settlement upon land riparian to a stream "gives ample notice that the water for all necessary domestic uses is, and will continue to be, demanded as appurtenant to the land entered, as much so as would a diversion of the water for such purposes." This is the exception referred to in the conclusion above quoted.

The opinion in this case is noteworthy for features other than the riparian doctrine. The court has shown a most modern view of the use of water for irrigation. The water rights are determined for the irrigated lands instead of for the ditches, as has been so wrongfully done in other water right decisions. An excellent exposition of the "duty of water" is given, and the decrease in the amount of water necessary, due to the introduction of improved methods and the length of time for which lands have been irrigated, is fully recognized. The duty of water actually accepted in the opinion is about one cubic foot per second for

eighty acres, which is certainly a step towards economy for a mountain community.

In insisting that all users of water from Silver Creek be made parties to the suit, the court determined in this one action the rights of every one interested. Had the action as originally brought been decided, only the rights of three parties would have been adjudicated, thus leaving the way open for a multiplicity of suits and continual contention over the alleged wrongful diversions of the waters of the stream. At the time this suit was brought (1900) there was no specific statute authorizing a court to require all parties interested in the waters of a stream to be brought in. Such a statute was passed in 1905. In this case the court relied for its authority upon a general statute.

In states which have not adopted modern legislation in regard to the protection of water rights, one of the most serious defects has been that even though a court might decide in a single action the rights of all parties using the waters of a stream, the decree would be of little value, as no public officer is provided to see that the provisions of the decree are carried out. In the present case the court realized this defect and held that "the court below should, in order to protect the rights of all the parties, or their successors in interest, enter such supplemental decree or decrees as may be necessary for that purpose; and, if at any time deemed necessary by it, the court should require the sheriff, or other officer or person as it may designate for the purpose, including an engineer or other assistant, as may be required, to fix at the points of diversion or other proper places suitable boxes or headgates, with a view to being able, in accordance with this decree, properly to measure, regulate and distribute the water between those who, under this decree, may be entitled to the use thereof, the costs for which should be taxed against each in such proportion as the court may deem just and equitable."

There are four essential features to be covered by an irrigation code. They are, first, that beneficial use should be the measure and limit of the right to the use of water and that said right should be appurtenant to certain designated lands; second, a direct and inexpensive method for the determination of existing rights; third, provision for the diversion of the stream flow according to priorities in time of scarcity; fourth, the control of all new appropriations by a state engineer. The Supreme Court of Oregon, in the case considered, covers in its opinion the first three features enumerated above. Legislation by the State of Oregon incorporating these features would, therefore, be merely declaratory of the law of the state as laid down in this opinion.

RECEIPTS FROM TRACKLESS TROLLEYS.

The cost of constructing trackless trolley systems in England was given by a recent lecturer as $15,000 per mile of route, as against $50,000 per mile for the usual rail system. The cost of working is about 11 cents per car mile. Receipts depend upon local conditions. At Leeds they were given as 21 cents per car mile and at Bradford 16½ cents.

MOTOR APPLICATION.[1]

BY W. S. HOAG.

This embodies a very broad subject—a volume might be written on each of one hundred distinct phases. The steel mill, the foundry, the factory, the great railroad repair shops, are all subjects we have seen elaborated in the pages of our technical magazines. Nowadays, we might think that a motor is universally and successfully applied wherever electric power is available, but upon closer observation, is this true? Is motor application universal under the lines of a power company? After careful consideration our answer is, "No, it is not universal—only partially so."

Permit me to call your attention to the two broad divisions of this subject—the things that are for and the things that are against the universal application of motors. The important things that are tending to promote universal application of the motor are, first, the power companies.

Every up-to-date power company has its well organized "New Business Department," equipped with a corps of expert solicitors, whose business it is to sell power to anyone under the company's lines who can use the power and pay the bills. The solicitor is a salesman; directly, he sells electrical energy; indirectly, he sells motors. His duty is to convince his progressive customer that he should use electric power to drive his shop or mill in preference to the steam engine, or the gasoline engine, or the oil engine. After numerous calls, automobile rides, and theater parties, he secures his prospect's signature to the contract and the deal is closed. The power salesman has done a good job; he has earned his salary; he has secured business which means revenue for his employer; the customer is satisfied because he has succeeded in contracting for his power at a few dollars per year less than he could secure power in any other way.

The next most potent factor tending toward the universal application of motors is the motor manufacturer. The manufacturer in most cases, is a large company representing millions of capital, whose very existence depends upon the manufacture and sale, in large quantities, of motors made up from a few standard designs. This company is equipped with a carefully organized sales department, whose branch offices are located in every corner of the globe and whose salesmen are eagerly on the job wherever a market is to be found for a motor. Again, a prospect is discovered, and said prospect in the hands of the professional salesman is soon turned into a good customer.

The third, but less potent factor tending to promote the general application of motors is the great success of the motor itself.

It is very general information that the motor, when properly applied, can do its work more successfully than any other method of drive. It is cheaper to install and more economical to operate. The majority of those who use motors are satisfied with them; that fact in itself is recommendation of the strongest kind.

Secondly: What are the things that tend to prevent the universal application of the motor? They

[1]Paper read and discussed before Los Angeles Section A. I. E. E., April 30, 1912.

are two in number; first, the failures of the motor drive; second, the cases where customer can produce power by some other means more economically than he can buy it of the power company. We will dismiss this subject entirely, as it does not have any bearing on the point to be emphasized; therefore, let us look directly into the causes for the failures of motor drive, and further, let us see who are responsible for these failures.

Causes for failure are:

(a) Insufficient capacity in the line.

(b) Motors improperly selected.

(c) Motors improperly applied.

Now, who are responsible for the failures due to the causes above mentioned? Obviously, the responsibility lies with the power company and the motor manufacturer and the customer. Each one, or all of them may be to blame in any particular case of failure. It is my personal opinion that the causes for ninety per cent of the motor failures are chargeable equally to the power companies and the motor manufacturers. We will therefore dismiss the few cases wherein the customer is to blame, for he is not supposed to know anything about motor drive and in fact always leaves these questions to those who are recommending to him the installation of the motor.

Let us note a number of cases and then we can better judge for ourselves. Let us keep carefully before us the fact that in nearly every case of motor failure, the customer is ignorant of the kind of motor required or the methods of its application and that the engineering information and the motor specifications must come from the power company or from the motor manufacturer.

Example No. 1. The customer, approaching the manufacturer desires to purchase a 30 h.p. motor to drive a certain machines; careful inquiry shows that conditions will be very heavy; the manufacturer recommends the purchase of a wound secondary motor but the power company objects to this, although the wound secondary motor would be easier on the power company's lines than the standard squirrel-cage motor. The power company's reasons for objecting are that the standard squirrel-cage motor is O. K. and they do not want anything special on this installation, as the customer might think that his problem was too special for motor drive. The power company is in a hurry to get the customer fixed up with a motor for fear he will change his mind and buy a gas engine Thus encouraged by the power company, the manufacturer (a), we will say, will change his squirrel-cage motor, because he knows that the manufacturer (b) will: or if (b) will not, he knows that (x) will, for (x) likes to rush in and grab out an order of this kind and cash in quickly while the market is good. Thus competition forces a quick sale and the motor is promptly installed. The motor takes three times full load current at starting, pulling the line voltage down 40 per cent. Here we have an interesting condition that no automatic protector device manufactured in the United States will fulfill. After the customer has had a couple of burn-outs, costing him approximately $150 each, he discards his motor and installs an engine.

Example No. 2 A man is operating a 200 h.p. in three different units; he has all his motors burned out and has to re-wind them all inside of twelve months. In addition to this, he suffers several thousand dollars' loss in business, all because his motors were not properly selected, properly installed and properly protected.

Example No. 3. In another case similar to the above, a man discarded a 75 h.p. motor and installed an engine in its place; this case, however, was purely customer's fault, as he did not select the proper kind of motor for the work at hand; at least, so the power company said.

Example No. 4. In another case, the motor manufacturer induces customer to buy a motor twice as large as is required to do the work; in this particular case, a motor built on a 25 h.p. frame was purchased to carry a load of approximately 7½ h.p. Average operating efficiency was about 50 per cent, where it should have been 85 per cent. After three months' trial a good live gas engine man can easily sell this party a new gas engine to replace the motor.

Example No. 5. In another case, a large manufacturing concern discarded its old, worn-out steam engine and installed a 100 h. p. motor; this motor is driving 35 different machines through the medium of about 200 feet of heavy line shafting and its accessories —pulleys and belts. This company's power bill for the first year was pretty high and showed little economy over steam; to remedy their troubles, they discarded the one large motor and installed four smaller ones. This helped matters considerably but it is obvious that maximum economy can be obtained only from the use of 35 different motors. It would be a crime to put a good live steam engine salesman on this job, for I fear he would get the order.

Why are these cases failures? Simply because the motors are incorrectly selected or improperly installed. A word of admonition to both power company and motor manufacturer would point out to them that while no one disputes their right to extract from their customers every dollar they can get, yet such absolute disregard of the fundamental principles of electrical engineering as has been cited above can have only a detrimental effect on the power and motor industry in the long run. If new business nowadays were not so easily obtained, perhaps more attention would be given to the lost business and the causes occasioning such loss. Would it now be wiser, in view of these conditions, to replace some of the power salesmen and the motor salesmen with expert consulting engineers, whose duties would be to seek out and recommend a remedy to these live, steam engine and gas engine prospects? Why should not every motor user be an enthusiast on motor drive?

What is the remedy for these conditions? Obviously, the employment on the part of the motor user of a disinterested and competent consulting engineer to solve his problems, draw his specifications and to assist in purchasing the proper kinds of apparatus to successfully perform the work. The engineer would then take charge of the installation of the apparatus and would see that it was properly protected from both electrical and mechanical injury. Acting in this capacity, the consulting engineer would readily solve this problem of the business relation of customer, manufacturer and power company to the end that failures in motor application would be less frequent than they are today.

HIGHER EFFICIENCY AND LOWER RATES.

BY GEORGE A. DAMON.

The men who are engaged in the technical department of the business must be expected to make great advances. Do you know that the total efficiency from the heat units in the fuel oil burned under the boilers in the Long Beach plant through all the processes of transformation of energy until it leaves the incandescent lamp in the form of light rays is only six-tenths of one per cent? Now the little firefly makes its light practically without any heat loss. It is very nearly cold light and has an efficiency of almost 100 per cent. Now I know that the men who are engaged in the technical end of the business are making great improvements. Since the introduction of the tungsten lamp, for instance, the amount of light per kilowatt hour has been increased three-fold. The completion of the Long Beach Steam Plant will enable you to produce power at a cost less than it has ever been generated by steam in this district, but you will readily see that there is still the greatest opportunity for the reduction of rates through the increase of the technical efficiency of your equipment. The subjects discussed at these monthly meetings of the employes of your company show that you are awake to your technical problems and possibilities, but you can still further study the leaks in your generating plants; you must lose no opportunities to increase your load factor, your power factor, and your diversity factor; your system of transmission and generation must be arranged to the best advantage and you must give every assistance to your customers in the selection of the proper kinds of lamps and appliances and the proper size and kind of motors so that even after your product is delivered it will be used to the best purpose. What an inspiration that little firefly must be to our technical efforts.

The financial questions involved in the reduction of rates are of equal importance to the technical problems. At the present time it requires about 50 per cent of your earnings to take care of your financial burdens of fixed charges, dividends, renewal fund and the authorization of your investment. Scientific regulation must eventually take care of all these requirements if it is to secure the reduction of rates without the actual confiscation of the property.

Out of your earnings there must first be allowed enough to pay the operating expenses for producing adequate service. There will come a time when new equipment must be purchased to replace the obsolete or inadequate equipment and unless the earnings have been sufficiently large to provide for a renewal fund at the same rate that the depreciation has been taking place, the investment in new equipment must be capitalized and there will be a pyramided capital account containing more than one dollar of investment for each dollar's worth of equipment, so that the second requirement of financial efficiency means an adequate depreciation account.

The next part of the financial problem is to pay the interest upon all bonds or other evidences of debt, and in addition to pay dividends which will represent fair return upon a certain amount of actual investment and also something more than mere interest charges in order to compensate for the enterprise of starting and carrying on the business. It should be recognized that a fair return must be something greater than just ordinary mortgage interest rates.

Now one of the fundamental principles of regulation in the future must be that, if this rate of return upon the investment is to be limited, then the actual investment in the property must be absolutely protected. In other words, that if the fixed charges and profits of the business are to be reduced to their lowest terms, then public regulation, in order to secure the lowest rates, must protect the investor and the greatest measure of financial efficiency will not be reached until this result has been obtained.

In addition to the financial requirements already mentioned public regulation should insist upon the accumulation of a surplus. We would not think much of any other business if it was run upon such a narrow margin that it would have no surplus available to take care of contingencies such as unexpected accidents, temporary losses of the business due to panic conditions, etc. In fact the opinion is gradually being reached that scientific regulation can be obtained in no better way than by the public control of such a surplus fund. This method of control would secure its results by first insisting that the companies earn a surplus and in order to make this surplus as large as possible, every detail of operation and every requirement of the financial arrangements must be thoroughly scrutinized. The accumulation of this surplus would, at once, remove a large part of the hazard in the business from the shoulders of the investors and by thus acting as an insurance fund should reduce the "cost of money" to a low limit. Furthermore, after this surplus had assumed sufficient proportions, it could act as a measure by means of which the public regulating bodies could control the development of the business. For instance this surplus fund could be used for any of the following purposes: to enter the lines into non-paying territory somewhat in advance of actual need; to provide modern improvements even before the old equipment has been entirely worn out; to decapitalize that part of the investment which represents development expenses or to reduce the rates. I believe it will be perfectly possible in the future, by the wise administration of such a surplus fund, to do all of these things. If rates are not reduced too fast, the increase in the technical efficiency which is bound to come, and the lower rates of return which can be secured by protecting the investment, can be combined to produce net earnings which may be used by the public for the continuous and automatic reduction of rates.

REDUCTION IN SAN FRANCISCO TRANSBAY TELEPHONE RATES.

The State Railroad Commission has obtained from The Pacific Telephone & Telegraph Company a cut of 33 1-3 per cent in the toll charges between San Francisco and the cities of Oakland, Alameda and Berkeley. The present rate is 15c for a conversation of three minutes. Beginning July 1st, this rate will be cut to 10c for a conversation of three minutes.

HIGH AND LOW PRESSURE HEATING—QUESTIONS AND ANSWERS.

Journal of Electricity, Power and Gas:

In reference to the two systems of underground heating which are now being installed in San Francisco and Oakland, I would be glad to have the relative merits of both systems discussed from a standpoint of economy for revenue.

The low pressure system utilizes the exhaust steam from a steam turbine or engine, which exhausts directly into the line against about six or seven pounds back pressure. With this method they have an income from the sale of generated current and exhaust steam. In the high pressure system, the steam is turned direct from the boiler into the high pressure lines at from ten to one hundred pounds gauge pressure. In this case, they have a revenue only from the sale of steam for heating systems and an occasional opportunity to operate steam driven pumps which have already been installed in buildings to which they sell steam.

Believing there is an opportunity for further study on above systems, would ask to have the relative merits discussed in your valued paper.

1. Which system is the most economical and pays the best revenue?

2. Has the high pressure system any gain in commercial heating value over the low?

3. Will there not be a greater condensation loss in the high pressure system on account of the higher temperature?

4. What is the relative amount of condensation in each system?

5. What is the relative cost of each system?

6. Which system will have the least number of shutdowns due to leaks, and will not the high pressure system cost considerable more to maintain?

7. Will there not be a greater revenue from the low pressure when due consideration is given to the returns from the sale of current and exhaust steam?

A SUBSCRIBER.

As my experience has been confined entirely to low pressure system of steam distribution it is not possible for me to make authentic comparisons. However, I will reply to your questions numerically, as completely as possible.

1. By "economical" I presume is meant the distribution efficiency. With a low pressure system the radiation per sq. ft. of pipe surface is undoubtedly less than with high pressure, but the larger mains required by the low pressure system afford considerable more surface for radiation, so that I would look for really more condensation per block of street mains in the low pressure system. Exhaust steam is, of course, saturated or contains a certain percentage of water in suspension. High pressure steam, on the other hand, may be somewhat superheated when leaving the stations and this superheat may neutralize radiation to such an extent that but little steam is condensed in the system adjacent to the stations. I think, however, that the deciding feature of economy between the two systems is that of leakage. The low pressure system can be kept perfectly tight, whereas it is, apparently, difficult to keep the high pressure system free from leaks. A small leak in a system carrying over 50 lbs. of steam will discharge an enormous amount of steam.

2. I think there is practically no difference in the commercial heating value of the two types of service. High pressure steam has to be ultimately reduced to low pressure for building supply and while it may carry sufficient heat to slightly superheat when passing through the reducing valve, I would not expect this to be the case.

3. As stated in reply to No. 1, this will depend upon the quality of high pressure steam. If same is superheated there would probably be a greater condensation per sq. ft. of surface, due to the greater radiation. Per block of system, however, I think the low pressure system would show greater actual condensation.

4. I have no data from which to compare condensation of high and low pressure systems.

5. Concerning cost—I have no data from which to make comparisons, but I would presume cost of high pressure system as compared with low pressure would be in about direct proportion to the pipe sizes involved.

6. The low pressure system if properly installed requires absolutely no shut down except to connect new services. The maintenance of the system is practically nil. I have no information as to shut downs or maintenance of the high pressure system.

7. This will depend upon the relative prices of steam and electricity, the water rate of the electric generating units operating against back-pressure as compared with condensing units, and the relative costs of the steam and electric systems.

Yours very truly,

J. G. De REMER,

Chief Engineer, United Light & Power Co.

PROPOSED POWERS FOR ONTARIO HYDRO-ELECTRIC SYSTEM.

A bill has been introduced in the Provincial Legislature of Ontario conferring on the hydroelectric commission the following powers, among others:

To take over existing power-transmission lines and to improve water powers, by assisting municipalities and others in the storage of water, making of sluices, etc.; to regulate the installation of electrical equipment and of wires in all building, including private houses; to control absolutely light and power rates charged by municipalities whether these municipalities take power from the commission or not; to direct the disposal of surpluses earned by municipal power plants supplied by the commission; to order all wires under its jurisdiction to be laid underground in cities and towns; with the co-operation of the Dominion Railway Commission, to order to be laid underground all wires in streets where the municipalities construct tunnels or conduits to carry such wires.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Welcome N. E. L. A.

According to the Standard dictionary, one of the meanings of the good old Anglo-Saxon word "willa-cuma" or welcome" is the privilege to use and to enjoy. Such is the welcome the Journal desires to extend to the guests of the west; namely, the delegates to the Seattle convention of the National Electric Light Association now daily arriving from every city of our great country. Indeed such a welcome but bespeaks the love we all have for our brothers—the wise men from the east. Did we but use the word in its usual sense merely meaning that of "a hearty greeting given" no longer would we be true to western ideals and traditions.

The privilege to use, to enjoy.

What a world of meaning wrapped up in one word —"welcome"!!

Even now every mountain pass is alive with special trains bearing weary men to western hospitality. A year of faithful, painstaking planning has been put in by those having in charge the great convention soon to be called to order. Every indication points to a profitable program and an enthusiastic gathering.

You men of the east come to us with your older traditions. With experiences gained by hard knocks of an older community, and with a wealth of business ideas many of which we hope to absorb in our few days' mingling together. We of the west, on the other hand, have but two things to offer—one is the "gimp" and vivacity of youth and the other is a home with us in a land of opportunity.

Hence, bearing in mind these two offerings, the Journal, in behalf of your western brothers, extends to you a hearty good Anglo-Saxon "willa-cuma"—the privilege to use and to enjoy.

Over-all Efficiencies

When the words, "consider the ant, thou sluggard" were formulated by the inspired writer in the Good Book, it is hardly possible that he had in mind the casting of caustic remarks at the achievements of the modern engineer. Yet, on another page of this Journal Dean Damon of Throop Polytechnic Institute, tells us that the light-giving efficiency of the cousin of the ant, the fire-fly, is almost 100 per cent, whereas, of the energy generated at the Long Beach plant of the Southern California Edison—a plant possessing the most efficient equipment known to modern invention—only six-tenths of one per cent actually appears at the receiving end in useful light for the consumer.

In considering the over-all efficiency of the modern electric generating steam auxiliary, in other words in considering the ultimate ratio of actual light energy produced, to the energy known to be inherent in a pound of crude petroleum fired beneath the boiler, the paltry figure resulting is indeed striking. Especially is this true in face of modern wanton boasts raising engineering achievements skyward.

A number of factors enter into the combined or over-all efficiency in power plant economies. Some of these have been wonderfully improved in recent years. Indeed some factors seem so near perfection, it is a

question whether they can be improved materially without radical and at present unknown changes in methods of power generation.

In recent well authenticated tests it has been found that modern high grade boilers may operate with a total loss of less than 17 per cent. In a word, 82 per cent to 83 per cent of the available energy is found in the heat of the steam leaving the boiler. Again in conducting the steam to the steam turbine, about 90 per cent of this available steam finally enters the impeller blades.

At the turbo-generator, though this is apparently a wonderfully efficient mechanism, only 21 per cent is delivered in power from the terminals and after allowing for auxiliary apparatus, it is better to say only about 18 per cent is actually delivered. Finally, after deducting the energy lost in journeying through the step-up transformers, then over the transmission lines and through the step-down distributing transformers and measuring devices we find that only about 60 per cent of this energy reaches the consumer. But in converting electrical energy into electro-magnetic phenomena the actual light rays visible to the human eye comprise only 5 per cent of the total energy. Hence the actual energy available in terms of energy generated is

$.83 \times .90 \times .18 \times .60 \times .05 = .0067$ or $.67$ of one per cent.

In scanning the above the third and last factors are the most glaring inefficiencies, yet struggle and think as the inventive genius of man has done in the past half century, no means as yet have proved practicable. The only solution from a thermodynamic standpoint is to attack the problem from an entirely different point.

As to the improving of the latter factor, a world of opportunity awaits the inventor. No hit and miss discoverer, however, will ever chance upon its solution. He who wears the laurels for solving this question, namely that of converting electric energy into electro-magnetic light waves of length attuned to the visual range of the eye, thus transforming all energy into light, will undoubtedly be so akin to the infinite that he can readily solve the adverse problem. This adverse problem is that of converting efficiently electro-magnetic waves into other forms of energy—thermal, mechanical and heat, thereby opening to man's use a power so sweeping as to be almost beyond human conception. The radiated energy of the sun, known to be equal to 7000 horsepower per acre of earth's surface, would become available.

With such worlds of power at our command, we all could then say with T. A. Edison: "4 A. M. and nothing to do till morning."

The Lake Tapps Affair

It appears that a $40,000 concern on the White River threatens to enjoin through the courts the operation of the new $12,000,000 power plant at Lake Tapps, near Tacoma, a description of which project appears as part of the Puget Sound Traction, Light & Power Company system described elsewhere in this issue.

In the publicly regulated utility company the issue is not that of a $12,000,000 corporation pitted against a weak brother of but $40,000 in assets, but rather should the consideration be that of the greatest good to the greatest number of people.

It may be true that a man who formerly floated some small logs and shingle bolts acquired certain vested rights in a stream, but surely in equity it could never be proved as just and proper or in accord with principles of conservation of national energies and efficiencies to restrain a publicly regulated utility of millions invested, supplying human necessities to thousands of living souls. In a word the question at issue is not one of prior rights but one opposing public policy.

Commission Doings on the Coast

The first fruits of commission regulation are already evident. An educational campaign setting forth the scope and powers of the new commission is resulting in the favorable consideration of California securities by eastern financiers. During the past several months eastern bankers have sent personal representatives to the Coast in order to investigate the far-reaching effects of commission legislation in Washington, California and other western states. California, in particular, has been the recipient of unusual scrutiny, and as for the personnel of the California State Railroad Commission, it is doubtful if ever in their lives these five men have been as carefully appraised and rated as has been the case during this period of inspection. Indeed, if these five men appraise and rate public utility companies and their physical assets as thoroughly and as fairly as these investigators have passed upon them, and every reason is evident that such will be the case, satisfaction will result on all sides.

The financial houses on the Coast, especially those institutions largely engaged in placing California public utility securities, have done much to aid an early and correct publicity in regard to the recent public utility act. No small amount of credit is due one of the leading bonding firms of San Francisco for their earnest endeavors along these lines. A handsomely bound volume of three hundred pages, a review of which is found elsewhere in these columns, has been compiled and published by this enterprising firm, and distributed gratuitously among their friends and clients. This book deals throughout with the public utilities act of California, the personnel of the new commission and its function toward the people and toward the public utility corporations.

The gathering of accurate facts and figures concerning new commission legislation in the western states and the broadcast dissemination of this literature cannot help raising western securities to their proper position in the financial world. A sane, thoughtful, considerate realization of fundamental principles of right and justice has come over the big men representing commission and corporation interests alike. Little harm or injustice can possibly result when such is the case.

The more widely this feeling of mutual self-confidence is felt throughout eastern financial circles, the better for all concerned, and to all those aiding in this campaign much credit is due.

PERSONALS.

George Cole, of John R. Cole & Co., is visiting the trade at Los Angeles.

Samuel Insull, president of the Commonwealth Edison Company of Chicago, is at San Francisco.

T. H. Dooling has recently been transferred from the Portland to the San Francisco office of Pierson, Roeding & Company.

F. E. Blanchfield, sales manager of the American Ever-Ready Company, with headquarters at San Francisco, is taking a vacation in the mountains.

H. C. Hazzard, the service expert of the electrical department of the State Railroad Commission of California, has been appointed, also, assistant attorney to Attorney Max Thelen.

S. L. Shuffleton, engineer in charge of construction for Stone & Webster at the Big Creek plant of the Pacific Light & Power Corporation, left Fresno, Cal., this week for Seattle.

Matt Comerford, of New York City, the general president of the International Union of Steam Engineers, spent the past week at San Francisco on an official visit to the Pacific Coast.

H. C. Goldrick, Pacific Coast representative of the Kellogg Switchboard and Supply Company, will spend the coming week in an automobile trip to Los Angeles and return, transacting business en route.

H. B. Taylor, chief engineer of the hydraulic department of the Cramp's shipbuilding yards at Philadelphia, is at San Francisco, in company with **Henry S. Grove**, the head of the plant, on a tour of the Pacific Coast.

P. H. Coolidge, general commercial superintendent of the Pacific Telephone & Telegraph Company, and **C. W. Burkett**, general superintendent of plant, are making an inspection of the company's system in the Pacific Northwest.

P. D. Fraser, formerly high tension sales engineer with the General Electric Company at Portland, Ore., was recently appointed general foreman of operation and maintenance for the Great Western Power Company at San Francisco.

Geo. A. Damon, engineer with Bion J. Arnold, and dean of Throop Polytechnic Institute, delivered a paper before the Throop branch of the A. I. E. E. regarding "Technical Opportunities of Southern California" on May 31st at Los Angeles.

J. N. Mahoney, head of the switchboard department of the Westinghouse Electric and Manufacturing Company, who is out from Pittsburg on his first Pacific Coast tour, spent the past week at the San Francisco office of the company instructing the local men in the switchboard apparatus details.

John A. Britton, general manager of the Pacific Gas & Electric Company, and several heads of departments, spent last Tuesday and Wednesday, at Santa Rosa in connection with the hearing before the State Railroad Commission of the company's protest against the Great Western Power Company entering that city with a competing transmission system. Officials of the latter company were also on the ground to present their defense of their position.

J. B. Lukes, representative of the Stone & Webster Construction Company and The Truckee River General Electric Company, and **E. B. Bumstead**, engineer with Stone & Webster, have opened offices at 1211 First National Bank Building, San Francisco. The purchasing office for the construction of the Big Creek power plant of the Pacific Light & Power Corporation will be maintained in the Rialto Building, San Francisco, under the direction of **F. T. Berry**.

P. T. Hanscom, electrical engineer with the Great Western Power Company, and **A. G. Jones**, sales engineer with the General Electric Company, have been elected to serve two years, and **C. L. Cory**, professor of electrical engineering at the University of California, one year on the executive committee of the San Francisco Section of the American Institute of Electrical Engineers. The remaining members are **H. W. Crozier**, electrical engineer with Sanderson & Porter, and **A. H. Halloran**.

H. L. Cory left for the south last Tuesday. He will deliver an address at the annual meeting of the Sigma Xi Engineering Society of the University of Missouri, explaining why the damming of the Colorado river was a failure. He will, also, visit Purdue University at La Fayette, Ind., where he will attend a reunion of his class to which George Ade and other dstinguished men belonged. Later he will visit Augusta, Georgia, and render his report to the Flood Commission regarding the prevention of flood damage from the Savannah River.

Nearly every one of the 1912 graduates of the department of mechanical and electrical engineering at the University of California secured a position within ten days after graduation. This fact refutes the statement that is made, from time to time, by uninformed persons, to the effect that a large proportion of college graduates in these lines do not prove their ability by securing and holding good positions. To show the nature of the positions obtained, the following names and business locations are appended:

E. A. Abeel, engaged in hydraulic work with Marquardt & Galloway, consulting engineers at Big Bend plant of Great Western Power Company; J. B. Black, commercial department Great Western Power Company, San Francisco; A. F. Bridge, construction work for the General Electric Company in rebuilding a transformer at Isleton; F. E. Pernot, engineering corps of Pacific Telephone & Telegraph Company, at San Francisco; W. P. Custer, gas department Pacific Gas & Electric Company, Potrero Works, San Francisco; A. V. Guillou, distribution department, Pacific Gas & Electric Company at San Rafael; W. S. Heger Jr., interested with F. T. Mumma, 5124 Grove street, Oakland, as electrical engineer in connection with electrical installation and irrigation pumping work; Mr. Czarnecki, construction work, Pacific Gas & Electric Company; B. M. Mehl, distribution department, Pacific Gas & Electric Company, at Sacramento; R. W. Mueller, assisting G. C. Noble in testing work for Pacific Gas & Electric Company; G. E. Noyes, Southern Pacific Company's shops' at Sacramento; J. F. Pollard, assisting G. C. Noble in testing work for Pacific Gas & Electric Company; L. S. Ready, underground construction work, for Pacific Gas & Electric Company at Oakland; H. E. Sandoval, distribution department at University of California; E. A. Slater, gas department Pacific Gas & Electric Company, Potrero works; C. M. Smith, engineering department Pacific Telephone & Telegraph Company, at Portland; J. E. Wallace, in charge of stock supplies for a mining company at Virginia City, Nevada; W. D. Wolfe, drafting department United States Navy Yard, Mare Island; J. P. Zipf, with engineering force of Sierra & San Francisco Power Company.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

Frank Watts, manager of the McFell Electric Company, who was operated on a few weeks ago for appendicitis, has been removed from the hospital to his home and expects to get out again shortly. Judson McFell arrived from Chicago Thursday evening and attended the co-operative dinner. He will look after things until Mr. Watts is around.

The Standard Electric Company were awarded the clock, telephone and bells on the Girls' High School job for the sum of $2780.

The Southern Pacific and the Santa Fe Railroads have made a special rate of one and one-third fare from all points in California for the round trip to San Jose at the time of the annual convention of the State Electrical Contractors' Association. Going tickets will be on sale July 14th to 27th, inclusive, and returning certificates (when properly validated) will be honored and tickets sold at the one-third fare from July 24th to August 1st, inclusive.

RESERVATIONS FOR GOLDEN POPPY SPECIAL.

The following reservations have already been made on the "Golden Poppy Special" to the N. E. L. A. Convention at Seattle, June 10-14, 1912, from California:

R. H. Ballard, wife and daughter, Southern California Edison Company; E. M. Beal, Great Western Power Company; T. E. Bibbins, General Electric Company; Frederick Booth, Pacific Electric Heating Company; G. H. Bragg, Pacific Gas & Electric Company; A. C. Brandt, Pacific Gas & Electric Company; W. W. Briggs and wife, Westinghouse Electric & Manufacturing Company; John A. Britton, Pacific Gas & Electric Company; J. D. Butler, Pacific Gas & Electric Company; W. W. S. Butler, Western States Gas & Electric Company; Geo. A. Campbell and wife, Truckee River General Electric Company; R. J. Cash, General Electric Company; S. K. Colby, Pierson, Roeding & Company; John R. Cole, John R. Cole Company; C. F. Conn, J. G. White & Company; F. J. Cram and wife, Electric Appliance Company; E. R. Davis, Pacific Light & Power Corporation,; P. M. Downing, Pacific Gas & Electric Company; W. E. Durfey & Wife, San Joaquin Light & Power Corporation; C. A. Eastwood, Pacific Gas & Electric Company; W. E. Elliott; T. E. Fogelsang, Pacific Gas & Electric Company; Fred George, Pacific Gas & Electric Company; F. B. Gleason, wife and child, Western Electric Company; W. L. Goodwin, Pacific States Electric Company; F. S. Gray, Pacific Gas & Electric Company; E. R. Hallett, Louis Sloss & Company; Arthur H. Halloran and wife, Journal of Electricity, Power and Gas; F. G. Hamilton, Mt. Whitney Light & Power Company; W. W. Hanscom, San Francisco; Harry Hays, Mt. Whitney Light & Power Company; John Coffee Hays and wife; Carl Heise, Westinghouse Electric & Manufacturing Company; R. D. Holabird, Holabird, Reynolds & Company; J. H. Hornung, Great Western Power Company; A. M. Irwin and wife, Westinghouse Electric & Manufacturing Company; W. V. Jahant, Acampo, Cal; A. G. Jones, General Electric Company; H. H. Jones, Los Angeles; Mr. Junges, San Francisco; G. I. Kinney, Fort Wayne Electric Works; Phil Levy and sister, Levy Electric Company; J. A. Lighthipe, Southern California Edison Company; H. T. Markey, Great Western Power Company; C. E. Maynard, Great Western Power Company; Mr. Miller, Acampo, Cal.; H. M. Mosher, Pacific Gas & Electric Company; F. S. Myrtle, Pacific Gas & Electric Company; E. H. Mulligan, Los Angeles; F. H. Murray, National Carbon Company; A. J. Myers, Wagner Electric Company; L. H. Newbert, Pacific Gas & Electric Company; E. R. Northmore, Los Angeles; L. N. Peart and wife, San Joaquin Light & Power Company; Ralph Phelps, Safety Ins. Wire & Cable Company; H. P. Pitts, Pacific Gas & Electric Company; F. H. Poss, Benjamin Electric Manufacturing Company; C. G. Pyle and wife, Standard Underground Cable Company; E. A. Quinn, Allis-Chalmers Company; J. W. Redpath, Southern Pacific Company; H. A. Russell, General Electric Company; S. P. Russell and wife, H. W. Johns-Manville Company; A. B. Saurman, Standard Underground Cable Company; Robert Sibley and wife, Journal of Electricity, Power and Gas; E. Spraul, Great Western Power Company; F. Stone, General Electric Company; B. T. Story, Los Angeles; A. V. Thompson, General Electric Company; A. R. Thompson, Pacific Gas & Electric Company; G. S. Thompson, Great Western Power Company; J. Thompson, Pacific Electric Manufacturing Company; J. A. Vandegrift, National Electric Lamp Association; J. W. Van Huysen, General Electric Company; J. W. Varney, Pacific Gas & Electric Company; E. B. Walthall and wife, San Joaquin Light & Power Corporation; S. V. Walton, Pacific Gas & Electric Company; C. J. Wilson, Pacific Gas & Electric Company; J. H. Wise, Pacific Gas & Electric Company; A. E. Wishon and wife, San Joaquin Light & Power Corporation; Garnett Young, Telephone & Electric Equipment Company.

The tickets for these reservations and any ones that may be subsequently made, may be purchased at the office of the Southern Pacific Railroad at Market and New Montgomery streets on and after Monday, June 3rd.

ENTERTAINMENT FOR N. E. L. A. DELEGATES AT SAN FRANCISCO.

The delegates to the Seattle convention of the National Electric Light Association on the Red Special from Boston and New York, via the Grand Canyon of the Colorado and Pacific Coast cities are to be entertained at Los Angeles as detailed in these columns last week.

When they arrive at Del Monte on June 4, they will be met by a committee from the Electrical Development League of San Francisco. Enroute to San Francisco each guest will be decorated with an artificial California poppy bearing the imprint "San Francisco 1915." These guests will be met at San Francisco on the evening of the 5th, by automobiles and taken to the Hotel St. Francis, where California fruits, flowers and wines will be placed in their rooms.

On the morning of the 6th automobiles, provided by the Chamber of Commerce, will be in waiting for a trip through the city with luncheon at the Cliff House, the cars being placed at the disposal of the guests for the balance of the day. At 7.15 in the evening an elaborate banquet and vaudeville will be served at the St. Francis Hotel. On the 7th a trip will be made to Mt. Tamalpais with lunch at the tavern and on Friday evening the train will continue on its way to Seattle.

ERRATA NOTICE.

Geo. J. Henry has called attention to a number of errors in his article on "The Development of the Tangential Wheel," which appeared in our issue of May 25th, which are corrected as follows: Formula (4), p. 494 should read:

$$H.P._T = \frac{62.4\,Q\,h}{550} = \frac{62.4}{550}\,\frac{v^2}{2g}\,Q \;\ldots\ldots\ldots\ldots\; (4)$$

Formula (5) p. 495 should read:

$$H.P. = \mu\,\frac{62.4}{550}\,Q\,h = .1134\,Q\,h\,\mu = .001763\,v^2\,Q\,\mu \;\ldots\ldots\; (5)$$

The matter commencing with formula (9) p. 495, and extending to the bottom of the page, should appear as follows:

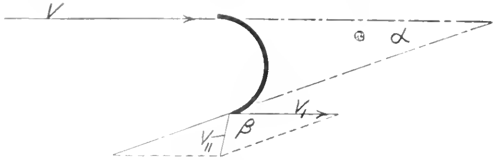


Fig. 24.

There is a velocity remaining in the water discharged from the sides of the bucket equal to

$$(v - v_1)\cos\alpha - v_1 \;\ldots\ldots\ldots\ldots\; (13)$$

The velocity which causes the impulse is then v — this loss or $v - [(v - v_1)\cos\alpha - v_1]$ .... (14)

and the force of impulse $F = \frac{w}{g}\,(v - [(v - v_1)\cos\alpha - v_1])$

$$\ldots\ldots\ldots\ldots\; (15)$$

Now if $v_1 = \frac{v}{2}$ and if $\alpha = o$, conditions sought to be obtained in tangential bucket design (15) may be written.

$$F = \frac{W\,v}{g} = \frac{124.8}{144}\;\frac{a\,v^2}{2g} = .866\,h \;\ldots\ldots\ldots\ldots\; (16)$$

Which as shown by formula 8 is twice the static pressure when the wheel pitch circle is running at 50 per cent of the spouting velocity.

INDUSTRIAL

NEW BENJAMIN FIXTURES.

Two new light fixtures of importance to the trade have recently been placed upon the market by the Benjamin Electric Mfg. Co. of San Francisco. The first consists of a deep bowl enameled steel reflector and a two-piece receptacle, and is intended to cover a range of lamps from 25 to 250 watts. Each reflector is suitable for two sizes and adapted for a maximum extensive distribution at approximately 40 degrees. They are particularly useful in shop lighting where it is desirable to protect the operators' eyes against direct rays; 7, 8, 9 and 11 in. sizes are furnished.

Deep Bowl Reflector Socket.

Sign Reflector Socket

The second fixture is a new sign reflector socket consisting of an integral enameled steel reflector measuring 11$\frac{5}{8}$ in. across the opening and set in position at an angle to secure an even light distribution on a vertical sign board. Either 60 or 100 watt lamps may be used.

Both devices may be equipped with the company's lamp grip consisting of a simple spring means which engages the lamp base with sufficient force to hold it in position. This feature is of particular value in places where the lamp socket is subjected to any considerable vibration.

IMMENSE POWER PLANT PROJECT.

The recent execution of a contract by the Lehigh Navigation Electric Company, Philadelphia, Pa., with the General Electric Company, Schenectady, N. Y., for three 10,000 k.v.a., 11,000 volt, three-phase, 25 cycle, complete horizontal turbo-generating units with the two 300 kw. turbo-exciter sets and one 300 kw. motor-generating exciter set, to be installed in its new main generating station at Hauto, Carbon, County, Pa., is significant of the progress of active constructive operations in the inauguration of the largest electrification project since the establishment of the Niagara Falls power plants.

Aside from the size of this work for the centralization of power generation and distribution, which contemplates an initial expenditure of $3,000,000 and definite plans for an eventual investment of $10,000,000, with an assured supply capacity of 20,000 kilowatts from the first installation of the three 10,000 kw. turbo-generators and a gradual enlargement to 100,000 kilowatts ultimate capacity, it represents the beginning of the most novel and important step toward the economic use of coal and the economic generation of electrical power on a tremendous scale by means of fuel that has ever been taken in the United States. Hauto, the site of the central generating station, is about ten miles west of Mauch Chunk and is at the mouth of a railroad tunnel leading from the main body of anthracite coal owned by the Lehigh Coal & Navigation Company at Lansford. From here the distribution of current for heat, light and power by means of high voltage transmission lines, reaching out through all eastern Pennsylvania and New Jersey, will penetrate a territory with 2,500,000 population.

By transforming the effective force of coal into electric energy at the mines and transmitting this direct to consumers and industries, one of the largest factors, the handling, loading, hauling over railroads and dumping, that enter into the cost of coal, will be eliminated. The company figures that still another economic saving will be realized. At present, it has a waste product of about 500,000 tons of coal a year. This consists of coal particles and dust which pass through three-thirty-seconds of an inch mesh screens. All this culm is entirely unmarketable and will be handled so as to be burned in the company's boilers.

The location of the main generating plant at Hauto was also determined because of an abundant water supply. An existing reservoir is being increased to a storage capacity of 1,000,000,000 gallons and an area of about 400 acres by the construction of a high dam. The water supply needs of the ultimate plant will be some 300,000,000 gallons a day, most of which will be carried back into the reservoirs after condensation. To run the plant up to the contemplated maximum installation of 100,000 kw. capacity, it is estimated that 1,000,000 tons of coal a year will be needed, a quantity of anthracite which would require 20,000 of the largest cars to transport to market.

Among the first power consumers in the district, it is planned to supply the slate and cement industries in Lehigh and Northampton counties, all of which are in a territory from twenty to forty miles distant from the Hauto plant. Substations will probably be established at once at Coplay and Pen Argyl for stepping down and distributing the current to users. Within a radius of fifty to seventy-five miles from the main station there are some twenty large cement mills. The transmission lines will be strung largely along the Lehigh Navigation Canal and on the right of way of the Lehigh and New England Railroad, which the company controls.

With the assistance of these companies a complete power census of the industries has been taken, and within the district which will be reached by the distribution system of the first section of the Hauto plant, over 100,000 horsepower is being used now. The Lehigh Navigation Electric Company has made up a schedule of prices, running from eight mills up to some two and a half cents per kilowatt-hour according to the amount of power contracted for and the steady continuance of consumption, which will deliver its current quite materially under the cost at which the industries are able to produce steam power.

Under the laws of Pennsylvania the right of an electric power company operating with steam to distribute energy is confined to a single township; accordingly, charters have been obtained in Lehigh, Schuylkill, Carbon, Northampton, Bucks and Montgomery counties for about sixty electric companies.

With the exception of the 8,000 kilowatt plant of the Harwood Electric Company, which supplies current for lighting and electric railway operation around Hazelton, using coal direct from its own mines, no attempt has been made heretofore in this country to generate electric current in the coal regions for public service. The Lehigh Navigation Electric Company expects to have the first installation at the Hauto plant in operation before the end of the year. As the capacity of the plant is gradually increased, energy will be carried to Allentown and Easton, Pa., Trenton, N. Y., and undoubtedly finally into Philadelphia. This city is within eighty miles and New York is only 105 miles distant.

THE GEM IRRIGATION PUMPING PROJECT.

Of late years the question of irrigation in the west has become an important one as far as the electrical industry is concerned, owing to the use of electric motors in connection therewith. One of the most interesting developments made recently is that of the Gem Irrigation District, near Boise, Idaho, where it has been decided to build a large power plant for the purpose of irrigating the land and furnishing electric energy to the farmers in that vicinity. The acreage to be irrigated is somewhat indefinite at present, but the water rights permit the irrigation company to provide for the use of 290 second-feet of water at a level of 55 feet above low water in the river, 210 second-feet at a level of 90 feet above low water, and 110 second-feet at a level of 160 feet above that of low water. The pumping station will be situated about fifteen miles from Caldwell, Idaho, in a deep canyon on the Snake River. The power plant, which will be completed in 1913, will be at Crane Falls on the Snake River, near Mountain Home, Idaho.

Electric energy will be generated at 6600 volts stepped up to 66,000 volts and transmitted to the pumping station 65 miles distant where it will be reduced by Westinghouse transformers to 2200 volts for application to the pump motors.

The Crane Falls Power & Irrigation Company, which will install and operate the necessary pumping and electric machinery for furnishing both water and power to the farmers of this district, has placed a large contract with the Westinghouse Electric & Manutacturing Co., induction motors, as follows: Three 1025 h.p., two 700 h.p., two 350 h.p. and two 255 h.p. Nine panel control switchboards and six 300 k.v.a. oil insulated self-cooled transformers, as also ordered.

For such irrigation as will be done during the season of 1912 power will be purchased and it is anticipated that the company's power plant will be in operation by 1913. Smith, Kerry & Chase of Toronto, Canada, and Boise, Idaho, supervised the engineering features and drew the specifications for the equipment. The International Steam Pump Company was awarded the contract for the pumps and, as above stated, the Westinghouse Electric & Manufacturing Company secured the contract for the pump motors and transformers.

BOOK REVIEWS.

Mathematics of Applied Electricity. By Ernest H. Koch Jr.; size 7½x5½ in.; 651 pages; 316 illustrations; cloth binding. Published by John Wiley & Sons and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $3.00.

The author—an instructor in mathematics, School of Science and Technology, Pratt Institute, has ably developed in this book the essential elements of algebra, plane gemoetry, plane trigonometry, and elementary principles of mechanics, heat and electricity. The subject matter is treated in three main divisions: The transformation and interpretation of formulas involving direct current problems; graphs of formulas and the formulation of graphs; and vectors and vector diagrams in treating alternating current problems. The purpose held in mind by the author is to bring to the student's attention the underlying basic structure of electrical phenomena so that he may formulate them, interpret them physically and work with accuracy and facility in making numerical and graphic computations. The book will prove useful to engineers desiring a ready reference to mathematical principles thus involved.

Valuation of Public Utility Properties. By Henry Floy; size 9x6½ in.; 390 pages; replete with diagrams and tables. Published by McGraw-Hill Book Company and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $5.00.

Henry Floy, member of the American Institute of Electrical Engineers and American Society of Civil Engineers, as a consulting engineer needs little introduction to the engineering profession. Mr. Floy's paper on Depreciation presented before the annual convention of the A. I. E. E. in June, 1911, created a profound impression and has been quoted most favorably in many technical discussions during the present year. The book at hand starts with a glossary on definition of terms in current use in valuations. The different phases of the subject matter—appraisals, expenses, franchises, goodwill, going value, depreciation—then follow in logical sequence. Since it frequently happens that the valuations of utility property are submitted to the scrutiny of the courts, references are frequently made in this book to the judcial rulings which, though at times contradictory and somewhat confusing, nevertheless indicate the general lines along which valuations must me made in order to render them unassailable. Certainly, this book, together with that of H. A. Foster's, recently reviewed in these columns, constitutes the most sound and complete treatment of the subject available in current technical press.

Public Utilities Act of California. Compiled and published by Eugene R. Hallett, manager Louis Sloss & Co., San Francisco. Size 6½x9½ in.; 300 pages; cloth binding. Complimentary Distribution..

No one acquainted with the vivacity and strennous makeup of the author of this work would hesitate to pronounce it a success even without examining the interior of its covers. The recent commission legislation in California has brought inquiries from all parts of the country relative to the far-reaching effects of the public utility law enacted within the past few months.

Mr. Hallett has in one fell stroke compiled such information on these lines as will answer at once all questions coming to the mind of the investor in California securities. The book opens with an introduction by Hon. Jno. M. Eshelman, president of the commission. A brief biography of the commissioners follows with a discussion of the utility act and its relations to the public by Hon. Max Thelen, attorney for the commission. A chapter on valuation of public utilities is next treated in a masterly manner by H. A. Lardner, Western manager for J. G. White & Co. A brief sketch of the leading railroad and public service commissions of America next appears, which is followed by an exact copy of all legislation in California creating the new duties of the commission. The work closes with a list of the rules of practice and procedure which have just been adopted by the commission. Finally, perhaps, the most important portion of the compilation is found in the complete and comprehensive index at the rear of the reading matter. Louis Sloss & Co. are to be congratulated upon the neat and careful manner in which the work has been gotten together, to say nothing of their enterprise

THE BALTIMORE & OHIO INSTALL MORE TELEPHONES.

The Baltimore & Ohio Railroad, which was one of the pioneers in the telephone train dispatching field, has recently placed another order with the Western Electric Company for selector equipment to be used in extending its facilities for dispatching trains by telephone.

The division to be equipped lies west of Cincinnati, extending from that place to Montgomery, Indiana, and branching off at Seymour, Indiana, to go to Louisville, Kentucky, and Jeffersonville, Indiana. There will be three circuits paralleling each other, one for transmitting train orders, called a "train wire," another for transmitting messages in general, called a "message wire," and a third, a "block wire," to be used to enable the block tower men to get into quick communication with each other. A feature of the message wire is that it is arranged for "intercalling," or, in other words, way-stations can call each other.

The apparatus to be used is the Western Electric No. 102-B type selector set, containing the No. 50 type selector. There will be one hundred selector stations so equipped, covering a stretch of approximately 250 miles. In all there will be over 800 miles of circuit, for train, message and block service.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL. The La Rica Water Company, $7500, subscribed $25, by H. K. Wheeler, M. Stewart, F. O. Franzier, F. C. Lamb and E. H. Bresee.

LOS ANGELES, CAL.—Seeley Electrical Laboratory, incorporators, W. W. Sweeney, J. E. Seeley, O. E. Campbell, W. D. Wickum, M. T. Terry, C. H. Bradley, J. P. Stockdale; capital stock, $30,000.

EL CENTRO, CAL. Articles of incorporation have been filed for the South Alamo Water Company, with George C. Richards, John W. Carter and Daniel K. Goode as directors; 4000 shares of stock will be issued of face value of $2.50 a share.

ASTORIA, ORE.—Articles of incorporation of the Elk Creek Light & Water Company have been filed. The incorporators are Orrin Kellogg, Otto J. Kraemer and Lester W. Humphreys and the capital stock is $5000. The principal place of business is to be at Elk Creek.

ILLUMINATION.

VALLEJO, CAL.—Bonds for a $100,000 municipal light and power plant were defeated.

PALO ALTO, CAL.—At the recent bond election among the propositions which carried were: $20,000 for a muncipal light plant, and $12,500 for the machinery to be installed in the plant.

EXETER, CAL.—Bids will be received up to July 10th, for the sale of the gas franchise, applied for granting the right to construct and maintain, for a period of 50 years, gas pipes under and along public highways of the city.

ARROYO GRANDE, CAL.—R. E. Easton has applied for a franchise for a term of 25 years, to furnish and sell to the city, natural and artificial gas, for light heat, fuel and power and to contruct and maintain gas pipes in said city. Sealed bids will be received up to 10th day of July at 7:30 p.m. for the sale of said franchise.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has been granted permission by the State Railroad Commissioners to buy for $41,200 the Kings City Water, Light & Power Company. This permission was granted with a proviso by the commission that it will not definitely accept the purchase price as a basis for making light and power rates in that locality without a formal investigation at the proper time.

SAN FRANCISCO, CAL.—The Harbor Board has directed Secretary Merle to notify the Pacific Gas & Electric Company, the Pacific Telephone & Telegraph Company and all other electric light and telephone companies to remove all poles and overhead wires on East street from the Ferry Building north to Lombard street. The companies will be advised that they must have all the poles removed and wires laid in underground conduits before January 1, 1913.

ROSEBURG, ORE.—That A. Welch, the Northwest railroad promoter, and power-plant operator, has purchased the Roseburg light and power plant formerly owned by J. L. and S. A. Kendall, of Pittsburg, Pa., is the current report here. In substantiation of the report it is known that "A. Welch & Company," with office address at Winchester, the location of the Kendall plant, have submitted a proposition to furnish the city of Oakland with light and water for a specified term of years.

STOCKTON, CAL.—The estimated cost of a conduit as reported to the Mayor and City Council by Prof. C. L. Cory, consulting engineer of San Francisco, is: underground electric conduit system, $115,768.50, incandescent electrolier lighting system, $96,820.32, total, $213,588.82. Professor Cory states that each post of the incandescent electrolier street lighting system shall contain five 60-watt metal filament lamps, equivalent to a total of about 250 candle power. The estimate is for 551 electroliers.

OAKLAND, CAL.—A saving of $15,000 will be effected in th municipal lighting bill for the coming fiscal year as the city attorney finds that the city can legally enter into a contract with the Pacific Gas & Electric Company as recommended by Commissioner of Public Health and Safety F. C. Turner to the Council. A call for competitive bids for lighting resulted in the Pacific Company filing a bid naming a price of over $15,000 below its bid of last year. The Central Oakland Light & Power Company entered a bid on district No. 5. Although its bid for this particular district was lower than that of its rival concern it was recommended that the contract be awarded to the Pacific company.

TUCSON, ARIZ.—The State Corporation Commission is to be petitioned by the Tucson Chamber of Commerce to investigate the service and rates of the Tucson Gas, Electric Light & Power Company, and the Tucson Rapid Transit Company. The former is accused of exorbitant charges, and failure to live up to the terms of its charter. C. C. Chappelle, president of both companies, has written the president of the Chamber of Commerce that the company now is preparing for the expenditure of $90,000 for the betterment of its system, and in extensions, and asking that the earliest possible action be taken in the official investigation as having an important bearing upon the credit of the corporation.

TRANSMISSION.

VICTORIA, B. C.—The second unit of the B. C. E. R. power plant at the Jordan River will be installed at once to meet the demand for power. Each unit of this plant represents about 6000 h.p. The cost of the improvement will be about $500,000.

LOS ANGELES, CAL.—The Aqueduct Advisory Board is discussing general plans for distributing the power to be generated from the Los Angeles aqueduct. Among the tentative plans considered was that of lighting the streets of Los Angeles under a series of assessment districts, but no definite plans were adopted and it is expected that numerous conferences on this subject will be held before plans are adopted.

VISALIA, CAL.—The Mt. Whitney Power Company has begun the construction of a new substation at Lindsay, which, when completed, will cost the company, $50,000. Although the present substation has capacity of 3000 h.p. and was constructed a few years ago with the prospect of a great demand for power in view, it has been found inadequate to supply the demand for power in the community. With a capacity of 10,000 h.p. the new substation will be the main switching plant of the Mt. Whitney system.

SAN FRANCISCO, CAL.—The Oro Electric Corporation has applied to the State Railroad Commission for a certificate of public convenience and necessity for the construction of a transmission and distribution line from its valley plants to San Francisco Bay The application of the Oro Corporation sets forth that it wants to serve portions of Plumas, Butte, Yuba, Sutter, Colusa, Yolo, Sutter, Sacramento, San Joaquin, Calaveras, Contra Costa and Alameda counties. All its franchise rights have not yet been received, it is stated, but the majority have been. The corporation now operates in Oroville and vicinity.

SACRAMENTO, CAL.—An echo of the old rate fight between the Northern California Power Company and the Sacramento Valley Power Company, which finally ended early this year in the Northern California's purchase of its rival, reached the offices of the State Railroad Commission, when the Northern California Power Company filed application to raise its rates. When the two companies were fighting for business, power charges were slashed right and left by both. When the Sacramento Valley Power Company was purchased by the Northern California, the latter immediately restored rates to the old basis effective before the rate war. The public utilities bill went into effect about that time, however, and the Commission immediately ordered the Northern California Power Company to reduce rates to the competitive basis, and refund all charges in excess of the amount it had been applying. This the power company did, it claims, and it has now presented a formal application to raise the rates.

HOOD RIVER, ORE.—"As soon as a right-of-way can be secured from J. H. Koberg, whose ranch surrounds Stanley Rock, from which point an aerial line of the Pacific Power & Light Company is planned to leave this bank to connect with the Husum line of the company in Washington, the management will begin the construction of the overhead transmission line," says Albert Hall, manager of the Hood River Gas & Electric Company of this city. The right-of-way was recently vacated by the Pacific Telephone Company, the lines of which now cross the river by cable. The Pacific Power & Light Company has three lines crossing the Columbia at the following points: Priest's Rapids, Pasco and Pendleton. The Hood River line, which will be 1982 feet, will be the longest over the Columbia. Under the supervision of Chief Engineer Galvani, H. F. Parsons has been busy during the last week with a crew of men resurveying the high power line between this city and The Dalles. P. M. Morse, City Engineer of Hood River County, has just completed the survey for an extension line of the company in the Mount Hood district and a crew of men is now busy in that community stretching the lines.

TELEPHONE AND TELEGRAPH.

ORANGE, CAL.—The Pacific Telephone & Telegraph Company has been granted a 45-year franchise to erect and operate poles and wires upon the public highways of the city.

COLVILLE, WASH.—The Deer Creek Telephone Company has petitioned the county commissioners for a franchise to erect a line in the public highway seven miles out from Gifford.

IMPERIAL, CAL.—The Imperial Valley Telephone Company, an Arizona corporation operating in the Imperial Valley, has asked the State Railroad Commission for permission to advance its rates, especially those on surburban service.

WHITE SALMON, WASH.—The Farmers' Union Telephone Company of Trout Lake has organized and will shortly incorporate with a capitalization of $50,000. They are selling stock for a line to connect with Underwood and across from there to Hood River. John Weingardner is president.

PASADENA, CAL.—The Pacific Telephone & Telegraph Company has petitioned the State Railroad Commission for permission to purchase the plant and capital stock of the Home Telephone Company of Pasadena, naming the price agreed upon as $370,000. The Pacific, in its petition claims to have an option on 4879 shares of the Home's capital stock out of a total of 5190. The price per share agreed upon is $44. The Home company places its valuation of its capital stock at $516,000 and has $471,000 in bonds outstanding, claiming total assets of $1,205,845. The Home company's gross income in Pasadena last year amounted to $128,880.

SEATLE, WASH.—The City Council is calling for data on the merits of different telephones and the cost of installing 20,000. Superintendent of Public Utilities A. E. Valentine is asked to furnish this information. The council also adopted Councilman Hesketh's resolution protesting against restrictions placed upon the citys' rights by the state public service commission in the matter of overhead and underground wiring regulations. The latter provides for a committee consisting of the president of the council, the chairman of the franchise committee and the superintendent of public utilities, to attend the hearing of the state commission and protest against restrictive measures.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company submitted minor reductions in a few rates before the Supervisors' telephone rates committee,, but no decision was reached. These changes were as follows: For two-party desk or wall phone, allowing four calls a day for 20c. The charge on each extra message was reduced from 5c to 4c. The same reduction for excess calls was made for the two-party, two-message a day phone, which costs 7½c a day. The new rate, which the company believes will meet a great popular demand, provides a charge of $4 a month for a one-party phone with an allowance of 50 calls a day. Extra calls will be charged for at the rate of 5c each. The committee took the matter under advisement.

PASADENA, CAL.—Steps are being taken rapidly for the consummation of the deal by which the Home Telephone Company will take over the Sunset at an early date. It now appears, however, that this purchase will be purely technical. The Home Telephone Company will be the purchaser, but, from advices received from San Francisco, it is now known that the Home company will be owned by the Sunset stockholders when this purchase takes place. In other words, the Sunset company has secured control of the Home, and will now turn around and assimilate its own corporation. The reason for this is that the Sunset company has no franchise, and, in the event of opposition being raised to a permit to do business being granted, it would have no means of operating. By first purchasing the Home company, it gains full control of the telephone situation, and also has a franchise. Thus, while the latest development of the situation appears, upon its face, to contradict the statement made by President Eason of the Home company, it really confirms it. In confirmation of this W. M. Eason, president, and MacD. Snowball, secretary, of the Home Company, say this is the initial proceeding to working out the merger of the two corporations.

TRANSPORTATION.

PASADENA, CAL.—Representatives of the Pacific Electric Railroad have applied for a 30-year franchise for a double track electric railway on Lincoln avenue.

PETALUMA, CAL.—The Petaluma & Santa Rosa Railway has purchased from George McNear a big tract of land in East Petaluma which has been occupied by the company for a passenger and freight depot, car shops and railroad yards. Surveyors are at work getting maps and estimates along Water street, preparatory for the extension of the road from this city to Point Pedro. Work on the line, which will go through from Petaluma to Santa Rosa, will commence this year, the road to run through by way of Cotati.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for constructing 13 cars for the municipal railroad on Geary street to W. L. Holman & Company at their bid price of $7700 for each car and $1500 apiece for four extra trucks. The specifications allow 270 days for the completion of the contract, but Vice-President Reiss of Holman Company stated that if wanted the firm would furnish cars ahead of time by putting on two or three shifts of workmen at the factories. It is expected that some of the cars will be ready in September, when the roadbed on Geary street will be about finished.

SACRAMENTO, CAL. Application has been made to the Railroad Commission by the Northern Electric Railway Company for permission to issue bonds in the sum of $1,100,000. The application states that the company proposes to construct an electric railroad, standard gauge, from Marysville through Colusa to Meridian, in Sutter county, and to bridge the Sacramento River at Meridian. The bonds are to run for 30 years and to carry 5 per cent. Bonds have been authorized by this company to the amount of $1,500,000, of which $150,000 are outstanding. It is now proposed that $1,000,000 be issued, to be used to carry forward the construction work.

SAN FRANCISCO, CAL. The Board of Public Works has awarded the contract for supplying electric power for the city railroad, to the Pacific Gas & Electric Company on that corporation's bid of 1c per kw. hour for direct current. This bid was considered low, the price being far less than the city could manufacture power for itself. The sums, amounting to hundreds of thousands of dollars, which were to have been expended in constructing a power house and substation for the Geary street road, may now be devoted to extensions of that line. The Pacific Gas & Electric Company offered to supply alternating current for a smaller figure—$0.0085 per kw. hour—but it was considered more economical to accept the 1c bid. The bids for substation equipment and for alternating current were formally rejected, and the Works Board directed the secretary to advertise for bids for the construction of the car house at Geary street and Presidio avenue. These bids are to be opened June 5. The car house is to be built of concrete, and three sets of specifications for it have been provided, bids to be received on each.

LOS ANGELES, CAL. The special committee of the City Council which conferred with Paul Shoup, vice-president of the Pacific Electric Company, and William E. Dunn, vice-president of the Los Angeles Railway, regarding the San Pedro street franchise and other traffic matters, has instructed Howard Robertson, deputy city attorney, to prepare an ordinance embracing the tentative agreement reached between the railway officials and the committee. This ordinance contains the following proposals: Pacific Electric Company to build a line on San Pedro street from Ninth to 4th street; Pacific Electric and Los Angeles Railway jointly to build from Fourth to Aliso street, where a third rail will be laid for yellow car local traffic; Los Angeles Railway to lay tracks from Aliso to the Plaza, when San Pedro street is opened by the city. City to have right to purchase the lines after expiration of three years from January 1, 1913, on giving one year's notice to railways, on these terms: Within five years, by paying cost of line; from 5 to 20 years by paying 75 per cent of cost; thereafter, on paying value of property; city to grant franchise for this relief free of cost. Routing of cars to be under direction of public utilities board; repairs, if not made by railways, may be made by the public works board and charged to the companies; erection of another passenger station connecting with the present P. E. depot by a bridge across Los Angeles street, with entrance on that street and also through the present P. E. depot; joint expenditure of about $350,000 by the two railways in equipment and buildings; railways to file reports of costs, and the city to make prompt payment on buying the lines.

SAN JOSE, CAL.—The San Jose Terminal Railway Company has filed an application with the State Railroad Commission to sell $950,000 in bonds and 350,000 shares of preferred stock of the par value of $1 per share, with the proceeds of which it is proposed to complete a combined electric and steamship line to connect San Francisco and San Jose. The company, according to its application, figures on an expenditure of $1,300,000 to establish quick interurban service between here and San Jose. The San Jose Terminal Railway Company has an authorized issue of common stock of 1,500,000 shares of the value of $1 each. The full amount is outstanding. It also has an authorized issue of 1,000,000 shares of preferred stock, valued by the company at $1 and 32,800 of these shares are outstanding, according to the application. In addition, there is an authorized bond issue of $1,000,000, of which $50,000 has been issued. The company proposes to construct an electric railway from San Jose through Alviso to deep water beyond the mouth of the Guadalupe River and there connect with steamers for San Francisco. The length of the proposed line is 43 miles—11 miles of rail and 32 of water. Both passengers and freight are to be handled. Combination boat and train service is contemplated to be arranged for quick itnercommunication between San Francisco and San Jose. The company, according to the application, proposes to spend $50,000 for terminal grants, $76,500 for the construction of a wharf at deep water and $335,000 for general construction work, including a drawbridge at Alviso to cost $20,000. The application is signed by John A. Mehling, vice-president, and M. J. Gardner, secretary. The Terminal Company is not a part of the San Jose Railroad Company or the San Jose and Santa Clara Railroad which fell into the control of the Southern Pacific Company in April, 1911.

WATERWORKS.

LONG BEACH, CAL.—Long Beach will soon be equipped with a $120,000 pressure salt water fire protection system.

OAKVILLE, CAL.—An election will be held June 4 for voting on a $6800 bond issue for a municipal waterworks system.

OXNARD, CAL.—The City Trustees rejected all bids for the purchase of $130,000 worth of municipal light and water bonds.

ALHAMBRA, CAL.—A meeting to determine where Alhambra is to get its future water supply is to be called in a few days by the City Council. Engineer T. B. Dower, who has investigated various sources of supply, declares that 11,250,000 gallons per day will be required. The city plans a municipal water system and among those being considered are San Gabriel Valley's Plant, Owens River water and the supply of the Chapman wells.

SALEM, ORE. H. Hirschberg, of Independence, has filed with State Engineer Lewis application to divert water of the Little Luckiamute River to be used for power for municipal purposes. The application is incomplete, as it does not tell what use will be made of the power derived from the stream, but Mr. Hirschberg said that it will be used to supply the towns of Independence and Monmouth with electrical power and also for irrigation purposes.

SAN RAFAEL, CAL.—The Board of Supervisors of Marin County have fixed June 25 as the date on which the citizens in Southern Marin County will elect five members to a board to examine schemes for a municipal water system. At a meeting last week the Municipal Water District Association elected the following as their candidates for the board: W. G. Morrow of Sausalito, C. J. B. Cheda and Patrick Ross of San Rafael, M. M. O'Shaughnessy of Mill Valley and Congressman William Kent of Kentfield.

BERKELEY, CAL.—That the people of this city may be compelled to pay a still higher rate for their water is the consensus of opinion of the city authorities, although every effort will be made to keep the present rate, which, in itself is considered high. In a report submitted to the City Council the People's Water Company stated that the percentage of profit for the last year was less than 4 per cent and that in order to get a reasonable return on the investment the present rate should be increased by the Council. The present rate for a 4-inch hydrant is $4 a year and the sprinkling rate is 30c per 1000 feet of water. The minimum rate for consumers is $1.50.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JUNE 8, 1912 | NUMBER 23

ELECTRIC DRIVE IN A COLORADO LUMBER MILL

BY R. B. MATEER.

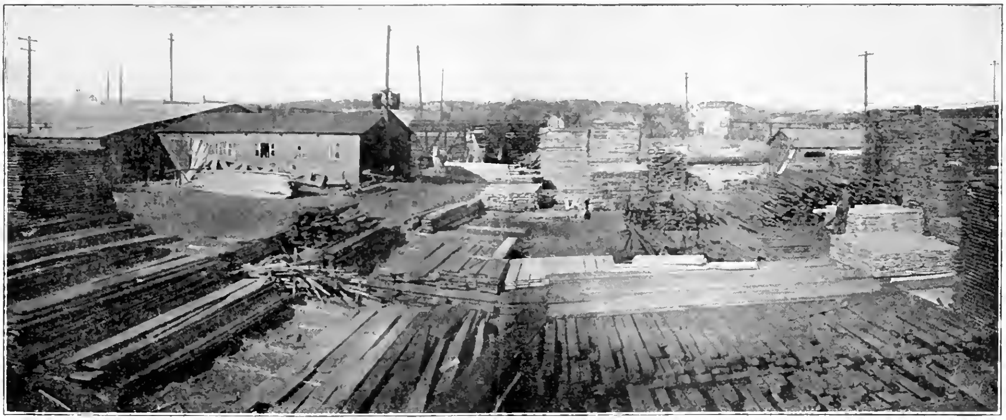
Timber lands are found in all parts of the United States. Nature provided for the growth of the tree. Man felled the tree and by mechanical operations converted the tree into a useful product suitable for human needs.

To produce the lumber for a home, economy has not been the watchword. Lumber camps were established in the forest and the tree, by wasteful methods, converted into rough lumber. The bark, the butt ends and in many cases valuable pieces of timber were used for the production of power. The cost of the power produced was high and today is further increased as the timber lands are rapidly denuded for the needs of man.

Many claim, and will continue to, that butt ends, slabs and scrub timber are not expensive as a fuel to produce power for the sawing of timber, but the educational campaign waged for the conservation of our natural products and their economical use continues with excellent results.

On the mountain ranges of Colorado is found much scrub timber. A commercial use for it was desired. Several enterprising men, noting the demand for boxes and crates, conceived the idea of using scrub timber for such crates and cases. A mill for this purpose was planned and steam, as a motive, contemplated. The refuse was intended for fuel.

An electric company, always on the lookout for an opportunity to secure a good day load, is operating in the same city in which the mill was to be located. Numerous conferences between the projectors of the mill and the power engineer of the electric company resulted in the use of electric power.

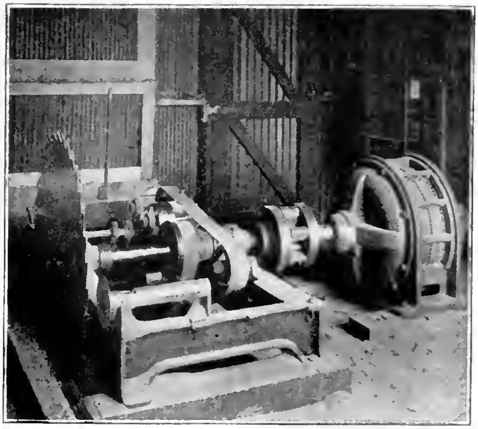


Motor Driven Mill and Yards of Western Box & Lumber Company.

Central station current transmitted at 2200 volts and then stepped down to 220 volts, now operates the plant, which today is using scrub timber and supplying many of the mercantile establishments with packing cases and crates.

Very little waste is found in this plant, which is modern in every detail. The timbers, 6 in. in diameter and 8 to 9 ft. in length, are brought to Denver by the Moffat Road. The car is switched to the Western Box & Lumber Company's mill, where the logs are unloaded and after being cut to 8 ft. lengths, are one by

one fed to an automatic saw, operated by a 50 h.p. General Electric three-phase motor. Here boards of any desired thickness are cut. The boards then pass through a sizing machine, which removes the rough edges and bark.


Motor Directly Connected to Saw.

Loaded on trucks, the boards are carried to the main building, where the planer, band saw and other machinery are operating, all of which machines result in the finished case or box.

A 20 h.p. General Electric motor operates the "Mershon" band saw, while a 25 h.p. General Electric motor operates the 26 in. "American" planer. The two cut-off saws, the two rip saws, a combination saw, a pony planer, a single re-saw, a matcher, the nailing and printing machine, are all belted to a line shaft operated by a 40 h.p. Fairbanks-Morse motor. All operations are by motor drive from the 5 h.p. on the cut-off saw to the 40 and 50 h.p. motors used in producing the finished crate or packing case.

But what of the waste or refuse, consisting of the butt ends, the shavings and sawdust? All are converted into good money. The butt-ends are sold to a wood dealer, who cuts them into suitable size, then sacks the kindling and finds a ready market. The slabs are easily sold to brick manufacturers in suitable lengths for furnace fuel. No waste so far.

The line shafting, the planer and large saws are each equipped with a blower, which drives the shavings and sawdust over screens and into proper bins. The shavings are disposed of for packing, where delicate articles need protection from the sides of packing cases. The livery men use all the shavings they can secure. Still no waste.

The sawdust. Well, it was somewhat of a problem. Yet a powder mill was found to be operating, not too far from Denver, and sawdust was needed What was simpler than to switch a box car on the siding and fill it and then ship the car and contents to the powder plant. Then some ice is stored in winter and some sawdust is needed. Some goods, when packed, are protected from breakage by the use of sawdust.

To study a prospective consumer's needs; to determine how best to secure economy and efficiency of operation for the consumer; to look about for a market whereby the customer may dispose of his by-product, that by-product which undisposed of is a men-


Interior View of Electrically Driven Mill.

ace to your plans; to urge and secure an outlay of money for electrical machinery and to make, above all, the consumer a satisfied one, gave our electric company a customer; yes more, a booster for electric power.

PRESIDENT TAFT RECOMMENDS A PATENT COMMISSION.

The patent situation has received important recognition from President Taft, who recently transmitted a special message to Congress asking for authority to appoint a commission to investigate the patent laws and report what changes are necessary to make them fit modern conditions. He refers in the message to a number of the more glaring abuses under the present system and particularly to the creation of such monopolies as were upheld by the now famous decision of the Supreme Court in the Dick case, saying that it is worthy of the most careful consideration whether or not legislation should be enacted to prevent the patent laws from creating an unjust monopoly beyond the protection to inventors which is so vitally necessary for the promotion of the arts and sciences, or to prevent these laws from being the means, on the other hand, of stifling progress and invention. The President also points out that any revision should not unduly interfere with the vested interests which have been built up under the present system, nor impair in any way the great value of this system to the country as a whole. He urges further that procedure under the patent laws be simplified and that the burden of proof in cases of contested validity be imposed upon the infringing party. The President's action in this matter is most timely and bespeaks an attitude which must inevitably be a source of great satisfaction to inventors and the general public the whole country over.

THE RELATION OF THE ENGINEER TO CONSTRUCTIVE CITIZENSHIP.

BY LESTER S. READY.

The past fifty years has been a period of enormous industrial development. Great transportation systems have grown, until now in America, every hamlet is connected with the large centers of industry. Electric generating and transmission systems have been devised and extended until at the present time they are among the largest factors in industrial civilization. Telephone and telegraph systems span the country from ocean to ocean, so that, as far as the transmission of intelligence is concerned distances are merely nominal.

Development nowadays is not by individual enterprise alone. Many of the problems to be solved by the engineer are placed in his hands by large corporate interests, the activities of which are of vital importance to the welfare of the people.

For a number of years the public has clung to the belief that the greatest economy would result from unlimited competition. They feared monopolies. Time seems, however, to have somewhat modified this original conviction. Those who are best qualified to judge of such matters have demonstrated that where duplication of investment and administration results, competition does not long remain effective. The truth of this conclusion has been exemplified in more than one great public utility.

In many instances, such as transportation, telephone, gas and electric power systems, it has been found that to obtain the greatest ultimate economy and therefore the best service at the lowest rates one comprehensive investment properly managed and operated must be maintained. Recognizing this, the government has appointed commissioners for the purpose of regulating and controlling the operation of such enterprises for the protection of the people.

The activities of controlling bodies, such as the Interstate Commerce Commission, and the many state public utility commissions have resulted where wisely carrried out, in improved service to the people and in protection to the corporate interests themselves.

A beginning has been made. The conditions and requirements of the people as well as of the corporations, however, must be more thoroughly studied in order that all phases of the subject may be fully understood and justice administered to every one.

To a large extent in the past the investigation leading to the control of these matters has been carried out by lawyers and practically trained business men. The representatives of the people have been slow to recognize that to cope with the intricate problems presented it is necessary to have specific as well as general knowledge of the engineering details involved. The assistance, therefore, and the advice of properly trained engineers is absolutely necessary to the success of all such public undertakings.

The great development along industrial lines has been due to a large degree to the engineering profession and now that the work of the engineer is changing from invention and construction to consideration of economic problems, it follows that the responsibility of the engineer to his employer and to the people should be based on broader civic principles.

No individual has a better opportunity to understand details or is more competent to advise than the properly trained engineer. He is not only fully aware of the service that should be given to the people, and the technical difficulties to be overcome, but he is also aware of the eternal vigilance necessary to the success of great public undertakings.

Such an engineer will not make his recommendations until all the facts have been established and the problem fully and carefully considered. His work has taught him that serious disasters may result if action is taken with insufficient data at hand.

The successful engineer knows the business conditions of the community as well as the financial possibilities governing the management of public utilities and he therefore can the more fully understand the necessities of the case.

The young engineer of today is in a unique position. With the knowledge of his profession, of business and its details, and with more than the ordinary acquaintance with the contemporary problems in his field he must realize that as a citizen his responsibility is great. As the designer and constructor of important engineering works he should materially assist in bringing about the highest possible economic development. No matter by whom employed he should bear in mind that while serving his employer he must as loyally serve the state and the community. In the work of his profession it is within his power to influence and establish that spirit of co-operation between corporate interests and the people without which no true success is possible. And by the exercise of clear thinking and unprejudiced judgment he may thus become a power in the development of constructive citizenship.

SUGGESTIONS ON STORING COAL.

With full appreciation of the fact that any or all of the following suggested precautions may prove impracticable or unreasonably expensive under certain conditions, they are offered by the Bureau of mines as advisable for safety in storing bituminous coal:

1. Do not pile over 12 feet deep, nor so that any point in the interior of a pile will be over 10 feet from an air-cooled surface.
2. If possible, store only screened lump coal.
3. Keep out dust as much as possible; to this end reduce handling to a minimum.
4. Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from the peak and form air passages at the bottom of the pile.
5. Rehandle and screen after two months, if practicable.
6. Do not store near external sources of heat, even though the heat transmitted be moderate.
7. Allow six weeks' "seasoning" after mining and before storing.
8. Avoid alternate wetting and drying.
9. Avoid admission of air to interior of pile through interstices around foreign objects, such as timbers or irregular brickwork, or through porous bottoms, such as coarse cinders.
10. Do not try to ventilate by pipes, or more harm may often be done than good.

SOME FEATURES OF THE DESIGN AND CONSTRUCTION OF DYNAMO ELECTRIC MACHINES.[1]

BY CARL E. JOHNSON.

Direct Current Machines—I.

Direct current motors, as we all know, are made shunt, series and compound wound. Although the operating characteristics are different the design and construction of each is about the same, so the following features briefly mentioned may be considered to cover all types.

Starting with the direct current armature designed mechanically right, we have our choice of using closed or open slots in which to place our windings.

Closed slots are used because they partially effect noiseless operation, afford a better distribution of the magnetic flux, and allow the use of a smaller air gap which is a decided advantage, especially in the smaller machines. The uniform and even distribution of flux minimize eddy currents in the poles. Then again in the use of closed slots are the elimination of the banding wires with their attendant troubles. The principal objection to the closed slot is the higher self induction in the short circuited coils, not to mention from the construction standpoint the physical difficulty of insulating in the slots, the bottom from the top of the winding. While open slots offer poor distribution of flux, this feature is off-set by the insulation obtainable and necessary in larger machines due to increased mechanical stress on the windings and for this reason are more generally used.

The selection of a given type of winding is only done after giving careful consideration to the desired preference, mechanical stresses and details after which the general arrangement is laid out.

It is always desirable to use a minimum amount of copper and to compactly arrange it in a minimum space, not losing sight of the necessity for ventilation. This is true of most all types of electrical machinery.

In direct current armatures the number of coils and slots, of which there usually are a large number to select from, each have their effect in determining the nature of the coils employed and the laying out of the winding scheme. In these, two types of windings are principally used which are known as multiple or lap windings and series two circuit or wave windings.

In the two circuit winding there are but two paths for current through the armature regardless of the number of poles and half of the total coils are connected in series in each path.

The lap or multiple winding has as many paths as there are poles and a corresponding smaller number of coils in series. As an example in two 4-pole machines, both of the same size, type and rating, if one is designed to be lap wound and the other wave wound, the wave connected armature would have only one-half as many conductors each of double cross sections in its periphery as the lap wound. Thus, it will be seen on small machines when the number of turns is necessarily limited the wave winding is usually much cheaper and easier to install. Another favorable feature of the wave winding is its ability to take care of unequal voltages in different sets of coils due to unequal gaps, wear in bearings, poor contact in some of the brushes, etc. With wave windings it is possible to use two sets of brushes, bearing in mind they must be of sufficient cross section to give proper current density at area of contact.

In some armatures of both multiple or series parallel winding cross connections are sometimes used. These can be arranged either on the rear-end of the commutator or directly to the armature coils. On a multiple wound armature the armature coils lying between two adjacent brush arms are influenced only by two main poles, when, on account of dissymetry in the magnetic system the air gap densities under these two poles are different from those under other poles; then a voltage will be generated between these two brush arms different from that on the other armature circuit causing the brush arms of the same polarity to receive different potentials which will make an additional current flow through brushes and brush-holder connections. These additional currents will overload the brushes and may cause sparking and heating of the commutator.

In multiple wound armatures the cross connections must be made between points of the winding that have the same potentials, the number of points usually agreeing to the number of pole pairs. The additional current mentioned will flow through the cross connections instead of through the brushes which obviously will improve the operation of the machine. However, the principal improvement through the use of cross connections is due to the fact that local alternating currents flow through the cross connections and the sections of the armature winding, which lead or lag with respect to the magnetic fields and which therefore exert magnetizing or de-magnetizing effects on the fields. The currents always flow in such a direction as to strengthen the weaker poles and weaken the stronger ones, in consequence of this equalization of the pole strength, the voltage of the armature circuits are equalized also so that they can all deliver their share of the working current.

Small direct current machines with ratings up to about one or two horsepower are mostly bi-polar. These machines possess inherently small space for the armature winding and are usually wound, except in the cases of very low voltage, with a large number of turns of small wire. They also offer poor facilities for ventilation. In these smaller bi-polar machines the hand winding is the most commonly used, that of threading the wires from a spool or spools through the small openings. The sizes larger than above mentioned are mostly of the multi-polar type which offer the selection of one of several kinds of designs or types of coils such as Eik Meyer, Bastard, Diamond and others. Of all these the Diamond shape coil is probably the most popular for the reason that it is simpler and can be made easily and cheaply and fit together well, making a perfect symmetrical winding.

In the smaller sizes the coils are usually wire wound and, if of the diamond shape, wound in a loop, and after being taped are pulled out until they assume the desired shape.

In the larger sizes the coils are usually made of strap copper which are wound or formed on wooden or metal moulds or forms.

[1]Paper presented before Los Angeles Section, A. I. E. E., April 30, 1912.

With each general style of winding there are numerous variations necessary, due to unusual desired characteristics which may or may not effect the form of the coil and the method of winding. With many of these characteristics, the pitch or throw of the coil plays an important part. Fractional pitch windings are used extensively because of the reduced voltage generated in the short circuited coil which improves, to an extent, the commutation. Other favorable features are decreased armature reaction and a saving of non-active copper which results in decreased copper losses. This winding is not usually advisable in commutating pole machines as it requires a very much wider pole to produce a commutating field wide enough to act on the short circuited coil during the entire period of short circuiting.

In wire or strap wound coils after the conductors are removed from the forms they are wrapped with a layer or layers of suitably treated paper or cloth which is held in place with an over-lapping layer or two of linen or cotton tape. The entire coil is then dipped in insulating varnish and baked. Through the whole operation of putting the coils in the core great care should be taken not to fracture or damage in any way the coil or slot insulation. After inserting the coils, and sometimes during, the leads are connected in their proper places to the commutator and thoroughly soldered, preferably with hard solder, after which the commutator is turned, polished, balanced, tested and painted.

The field coils of direct current machines are subject to mechanical and magnetic stresses and for this reason must always be well and suitably insulated between turns and the frame of the machine. The voltage to be withstood consists not only of normal excitation voltage but very often of excessive voltage occasioned by the so-called kicks of the fields on opening the field circuit without a discharge resistance as is frequently done. This kick is sometimes guarded against, to an extent, by the employment of a short circuited copper band around the field coil. Then again at times the windings must withstand the most adverse conditions of dirt, moisture, and oil and the insulation must be selected with these conditions in view. In order to insure high efficiency and low cost careful consideration should be given to the ventilation of field coils. The ideal condition is to have bare wire exposed on all sides to the air and this method has been used on larger machines to some extent in the past and has been incorporated to as great a degree as possible in some small machines of recent design. In most of these cases, especially the smaller machines, enameled wire is used for the reason that a larger number of turns can be put in a given space and it is capable of standing up under higher temperatures and also affords better radiation of heat. After the field coils are properly impregnated which consists of placing them in a closed tank, in which the temperature is raised to a high degree, and the air exhausted thus removing the moisture and air from the coils, a moisture proof insulating compound, in liquid form and at a high temperature, is then run into the tank until the coils are immersed in the compound; air is then admitted to the tank under pressure, forcing the compound into all parts of the coils. The melting point of the compound is higher than any temperature the coils are likely to reach in operation so that under normal conditions they form solid and absolutely waterproof units. The compound is selected with a view to being a good conductor of heat and thus assists materially in maintaining a low operating temperature. A final coating of waterproof varnish a good wearing surface which is easy to keep clean. This impregnating treatment is sometimes applied to armature coils and nearly always to transformer coils.

Compound or interpole coils for direct current machines are practically always wound of few turns of copper strap or wire and in the large sizes are usually of the strap on edge type. The impregnating process is seldom necessary on these coils of large wire as they contain but little absorbent insulating material.

(To be continued)

MOTOR APPLICATION.

The following summary of factors entering into the application of motors to industrial purposes should be read in conjunction with W. S. Hoag's paper on this subject which appeared on page 554, June 1, 1912, issue of the Journal of Electricity, Power and Gas:

When a prime mover with its sundry appurtenances, hazardous investment, incalculable maintenance, depreciation and inflexibility, improper capacity and overestimated load factor, is proposed, merely on the basis of apparently lower cost of power from raw material; it is time for the salesman to demonstrate the advisability of paying more for the finished product, metered proportionately to the actual requirements.

Assuming that good electric power service is available, it should receive the first consideration, and the installation of a prime mover only as a last resort.

Motors of improper size are being used due to many causes, imposing unnecessary burden on consumers and producers of electric power. To remedy this, first, do not let it occur again; to change the existing cases is a harder task. However, co-operation of engineers and salesmen, combined with more scientific commercial conditions, will work wonders.

Troubles in motor driven installations are usually due to unsuitable protective devices, and mechanical defects in motor starters.

Cartridge fuses are expensive to renew and frequently renewals cannot be obtained in the local market within a reasonable time; consumer then resorts to makeshift methods.

Individual drive is not always practical, it sometimes means too large a motor investment and sometimes increases the connected load, making the fixed charges burdensome. Advantageous location of machinery, however, frequently justifies individual drive when consumer can make the investment.

Spontaneous combustion of coal is brought about by slow oxidation in an air supply sufficient to support oxidation but insufficient to carry away all the heat formed. The area of surface exposed to oxidation by a given mass of any one coal determines largely the amount of oxidation that takes place in the mass.

DRAFTING ROOM PRACTICE, IV.

BY A. L. MENZIN.

In this article are given examples of the kinds of work which the mechanical draftsman is most often called upon to execute.

Fig. 1 is a detailed drawing of a casting which is to be machined. In this class of work it is important to specify not only the dimensions of the respective parts but also whether these parts are to be cast or machined to size, unless the character of the work is such that no distinction is necessary. For designating that a part shall be cast to size, it is customary to prefer the dimension by "cast" or "core" depending on the nature of the foundry work. For designating

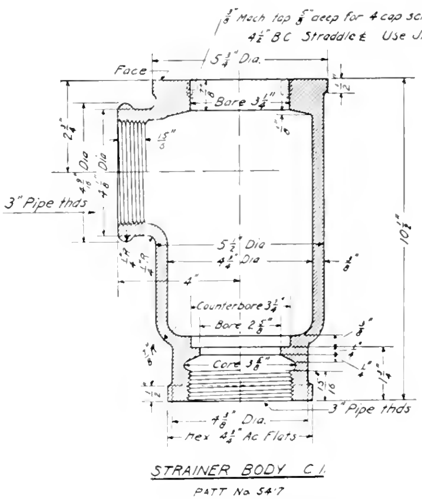


Fig. 1. A Drawing Illustrating a Machined Casting.

machined work the prefixes, "Turn," "Bore," "Counterbore," "Drill," "Ream," etc., are used. Another way of designating machined work is to place the letter f after the dimension or on the surface to be machined. Thus, if a hole is to be bored to a diameter of 2⅝", the specification may be either "Bore 2⅝"" or "2⅝" Dia. f." Sometimes it is preferable to use one method and sometimes the other.

It is often necessary for proper construction to have a part machined to a jig, wire-gauge, etc., or to be fitted to the part with which it connects. Examples of specifications for such work are given in Figs. 1 and 2. In Fig. 1 the holes in the top are to be laid off from a jig designated by number. The size and depth of holes, the bolt circle, and the relative location of holes are given for reference. In Fig. 2 the size of the square on the left hand end is not given but the specification calls for a "snug fit in the hand wheel."

Fig. 1 also shows how a solid may be fully described in one view. If the shape of a part is such that it can be easily and accurately described by means of words, it is preferable to do so rather than to draw auxiliary views. Thus, the specification "5½" Dia." indicates that the shape is circular. The specification "Hex. 4¾" Ac. Flats" is all that the patternmaker needs to construct the particular part referred to.

Fig 2 shows some additional specifications for machined work, particularly with regard to screw-threads. There are many different kinds of threads, and a complete specification of the particular threads desired should therefore be given. When the part is to have standard pipe or bolt threads, it is not necessary to give the number of threads per inch or to

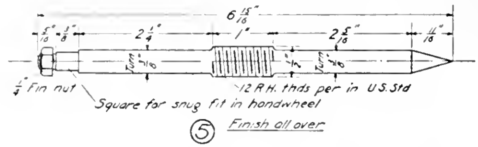


Fig. 2. Detailed Specification for Machined Work.

state whether the threads are to be right or left hand, U. S. Standard or otherwise. Such specifications as "½" Pipe threads" or "2½" Mach. threads" are sufficient. If a hole is to be threaded with a standard tap, the specification commonly used is "½" Pipe tap" or "½" Mach. tap," as the case may be.

In Fig. 2 is also shown a commonly employed method of designating a part by number instead of by name. Part numbers are usually enclosed in circles about ⅜ of an in. in diameter to give them prominence. For specific reference on bills of materials, orders, and for pattern numbers, these part numbers are very convenient. If a part has the number 5 on a drawing numbered D576, the reference is usually written as D 576—5.

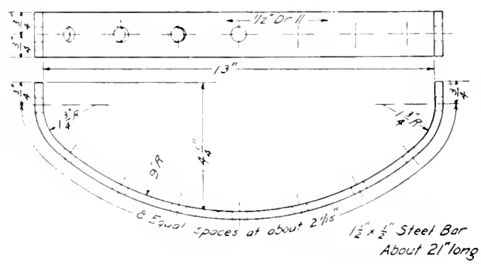


Fig. 3. Detailing of a Part of Irregular Shape.

Fig. 3 is intended to show some specifications in the detailing of a part of irregular shape.

When holes are to be laid off on a curved surface at equal distances apart it is usually preferable to give the information in a way which will enable the workman to locate the respective holes with a pair of dividers, instead of specifying the center to center distance, which is very difficult for the draftsman to determine. In Fig. 3 is shown the conventional way of giving this information. The object of giving the

approximate length of each space is to enable the workman to make a close setting of the dividers for the first trial.

When holes are all of the same size and are numerous or difficult to draw, it is often sufficient to show only the center lines of the holes, as in the upper right-hand corner of Fig. 3.

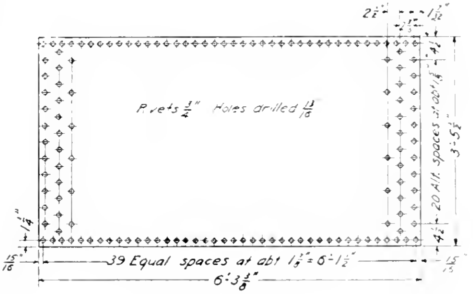


Fig. 4. Layout for a Triple Riveted Seam.

It is very desirable when a part is to be made out of stock material to have the amount of stock required given on the drawing, as in Fig. 3. This information is of great help in ordering the necessary stock promptly.

Fig. 4 shows a layout of rivet holes for a triple riveted, double butt-strapped longitudinal seam, and a single riveted circumferential seam.

BRITISH ENGINEERING ACTIVITY IN CHINA.

The current Electrical Review of London comments editorially on the recently formed British Engineers' Association. In view of longing eyes now being cast toward engineering openings in the awakened China by many Western men, the following excerpt is interesting:

An important association has just been formed, known as the British Engineers' Association, with the object of establishing itself as a great national organization for the promotion of the overseas interests of the British engineering industry as a whole—not to serve the interests of any one firm or clique, or to carry on trade in any way, but to overcome the obstacles by which our trade is hampered. The association was formed by twenty-two well-known British engineering firms, and even before incorporation (which took place on April 26th) it included some sixty members, most of them being firms of the highest standing, while others were awaiting election.

The efforts of the association will be directed for the present exclusively to China, where the organization and strengthening of British engineering interests is urgently needed; the constitution is drawn up on broad lines by no means restricting the action of the association to foreign trade alone, and includes the promotion or opposition of legislation, the circulation of information and statistics, support to the British Government and other influential organizations, and keeping a watch upon the methods and progress of foreign competitors. Other objects are to encourage the predominance of British technical instructors in Asiatic and other schools, to facilitate the training of Oriental engineers in British colleges and works, and to promote the use of the English language as the recognized medium of engineering business.

The importance of China as a market for British engineering products is so self-evident as to need no emphasis, and under the new regime, when things have settled down, there is every prospect that an enormous development will rapidly take place; China, in fact, will probably become one of the greatest markets for engineering plant, but whereas in the case of Japan our early influence was deeply established, and its effects are still active, in China we find ourselves at the outset in competition with our modern rivals, whose Governments, moreover, effectively assist their agents in diverting trade to their own people. In the absence of any similar support our manufacturers are well advised to join hands with a view to counteracting the strenuous campaign which is being conducted by Germany and the United States in the Far East. That immense benefits can be secured to British interests by energetic and judicious action is certain, and we gladly extend a hearty welcome to this very excellent association.

ACTION OF CALIFORNIA RAILROAD COMMISSION.

The application of the Stockton Terminal & Eastern Railroad Company for permission to issue $65,000 in bonds has been granted by the State Railroad Commission. The Stockton Terminal & Eastern is incorporated to run from the city of Stockton to the town of Jenny Lind in Calaveras County, a distance of approximately thirty miles. The line has been constructed and is in operation from Stockton as far as Fine, a distance of fifteen miles. Trains have been run since September, 1910. A steam service has been succeeded by gasoline motor cars. It is the intention of the Company ultimately to operate by electricity.

The proceeds to be derived from the sale of $65,000 in bonds are to be devoted to the discharge of obligations to the amount of $26,925.82 and for extensions and improvements.

Referring to its authority to pass upon proposed issues of stocks and bonds, the Commission says:

"It will, of course, be borne in mind by the investing public that this Commission does not guarantee bonds, stocks or other securities which it authorizes. Ordinarily the Commission's function in passing upon a proposed bond issue is personally to ascertain whether the purpose for which it is desired to secure funds is proper and whether the monies desired for such purposes are reasonably necessary therefor and whether the bonds are sold for a reasonably high price and to take the necessary steps to assure itself that the monies derived from the disposition of such securities are expended solely for the purposes authorized."

RAILWAY SIGNALING.[1]

BY J. S. HOBSON.

Shortly after the first steam railroads were operated in England, or about 1830, the need for conveying information to trains by means of signals became apparent and resulted in the use of a number of different designs. Each railroad followed its own ideas and having adopted certain forms of signals, arbitrarily assigned certain meanings to them irrespective of all other roads. As the original railroads were extended and connected with each other, interchange of traffic resulted. Consequently, the employes of one line whose duties required them to operate trains over foreign roads using entirely different signals frequently misread their meaning and accidents followed.

No radical attempt appears to have been made to standardize signaling, however, until after the adoption of the semaphore by Mr. C. H. Gregory in 1840. The semaphore, which, as everybody knows, consists of a mast with one or more movable arms, is one of the oldest known devices for conveying meanings by signs. Tradition says it was invented by a Greek named Polybius about two thousand years ago, who possibly conceived the idea from seeing a man make signs by holding his arms at different angles to his body.

The semaphore was used by the Romans and afterwards by practically all civilized nations for conveying information comparatively great distances before the invention of the electric telegraph and since its first adaptation to railroad uses in 1840, it has been developed and improved till it is now the standard signal on practically all railroads.

The semaphore has, however, one shortcoming, namely, that it cannot be seen in the dark, and although many attempts have been made to devise an illuminated arm, so far entirely successful results have yet to be attained. Consequently, all night indications and signals in tunnels and subways have to be displayed by lights of different colors.

About 1843 attempts were made to operate several signals and switches from some central point by means of a group of levers connected to them by wires and pipes. In the first plants so erected there were no locking devices to prevent the improper operation of the switches and signals, and man being fallible then as now, switches were occasionally thrown under trains, and signals for conflicting routes cleared simultaneously with the usual unhappy results. To overcome the first defect a device called the detector bar was invented, which consists of a movable bar longer than the greatest distance between adjacent wheels and attached to the rail by a series of radial arms or motion plates. The preliminary movement of the switch or lock lever to which this bar is connected tends to raise it above rail level and should a train occupy the track the detector bar will strike against the tread or flanges of the wheels and prevent further movement of the switch or lock. This device is still used on interlocking plants except where track circuit locking is employed, in which event the switch lever is guarded against wrongful manipulation by the presence of a train on a track circuit at the switch, controlling an electric lock on the operating lever.

The other defect in the first plants installed, namely the possibility of clearing conflicting signals, or clearing signals governing movements over switches improperly set, was overcome in 1856 by Mr. Saxby, who devised means for so interlocking the various levers in a plant, that they could be operated only in certain predetermined orders. Consequently the first real interlocking plant may be said to have been erected in that year, and though the plants of today vary in many details and are of course greatly superior, yet they all embody the broad basic principles contained in the first plant installed in 1856. These are:

First: That before a signal governing train movements over a certain route can be cleared, all switches in that route or in others conflicting with it must be properly set and locked, and all opposing or conflicting signals displayed in the stop position.

Second: That when the first named signal has been cleared no switches in the route it governs, or routes conflicting with it, can be unlocked or moved, nor any opposing or conflicting signals cleared, and

Third: No switch can be unlocked nor moved when a train is standing on or passing over it.

Interlocking plants were not introduced into the United States until 1874, or eighteen years after Mr. Saxby's first plant was built in England. This was doubtless due to two causes, viz: less congested traffic and smaller available capital per mile of railroad. In that year the Pennsylvania Railroad contracted with the Saxby and Farmer Company of England for the installation of an interlocking plant at East Newark, New Jersey, all of the material as well as the mechanics who installed it being imported from England.

This plant was shortly followed by others, both on the Pennsylvania and New York Central lines, and a few years later the American rights to the Saxby and Farmer patents were acquired by the Union Switch & Signal Company, incorporated in 1882. American ingenuity having become conversant with the interlocking system immediately proceeded to improve it and in 1876 a practical power interlocking was installed, experimentally, at Mantua near Philadelphia, under the patents of Prall and Burr. Soon afterwards Mr. George Westinghouse began to adapt some of the ideas embodied in his air brake to the operation of railway switches and also experimented with an hydraulic interlocking system.

A plant of this nature was erected at Wellington, Ohio, in 1882, and in 1883 and 1884 the first hydro-pneumatic machine was installed at Bound Brook, New Jersey, on the Central Railroad of New Jersey. The Bound Brook plant may be considered as the first really successful power interlocking and the forerunner of the present electro-pneumatic system now operating the majority of the great railway terminals in the United States, as well as hundreds of other plants both here and in foreign countries.

In the modern electro-pneumatic plant all switches and signals are operated by compressed air at from 75 to 100 lb. pressure, through the medium of cylin-

[1] Paper read before San Francisco Section, A. I. E. E., May 24, 1912.

ders and pistons connected directly to the switch or signal mechanism. The admission and release of the air to and from the cylinders is effected by ironclad electro-magnets of extremely rugged design which are in turn energized and de-energized through circuit controllers attached to the levers of the interlocking machine. These levers are interlocked by mechanical means similar to those employed in all other interlocking machines.

In 1888 Mr. John D. Taylor began experimenting with a purely electric system, which he first exhibited in the old Exposition Building, Chicago, the following year. After some further experiments he installed a practical electric interlocking plant at East Norwood, Ohio, on the B. &. O. S. W. and C. L. & W. in 1890-91, which was the first really successful plant of this type, although Messrs. Ramsey and Weir had erected an electric interlocking at College Hill, Ohio, on the C. H. & D. the year before.

There are several electric interlocking systems in general use today, in all of which the switches and high signals are operated by electric motors through gearing, and the dwarf signals by solenoids or motors.

As a general proposition mechanical interlocking plants with or without electrical accessories are the simplest and cheapest plants to install and operate where local conditions are favorable to their use.

Power actuated interlockings are employed first —where traffic conditions, such as a busy terminal, require very rapid operation of switches and signals; second—where switches and signals are at such distances from the tower as to render their operation by mechanical connections impracticable; third—where the plant is of such a size as to make its operation by power more economical than by mechanical means, both in the number of levermen required and the space occupied by the machine and its connections, and fourth—where obstacles, such as paved streets, narrow roadbeds, etc., make the location of mechanical connections difficult and expensive.

Block Signaling.

Block signaling, or the maintenance of a space interval between trains, is the second great branch of railway signaling and dates from 1839 when, at the suggestion of Messrs. Cooke and Wheatstone, the Great Western Railway of England began telegraphing the arrival and departure of its trains from station to station on a section of its line near London.

In 1842 Mr. W. F. Cooke laid down the following principles for a block system, which have been closely followed in all systems since devised:

Every point of a line is a dangerous point, which ought to be covered by signals. The whole distance consequently, ought to be divided into sections, and at the end as well as the beginning of them, there ought to be a signal, by means of which the entrance to the section is opened to each train when we are sure that it is free. As these sections are too long to be worked by a traction rod they ought to be worked by electricity. At the end of each section of from two to two and a half miles, a line-keeper is stationed in a hut, with a turning disk, or a semaphore. In each hut there ought to be two telegraphs with magnetic needles, the one on the right hand being in communication with that on the left of the neighboring hut. The needle telegraph can only give two signals: "line clear" or "line blocked."

The block system in England was improved from time to time by the introduction of electric locking and other checks between operators at adjoining stations, and the English are also responsible for the invention of the electric train staff and tablet systems for single track operation. In these last mentioned systems no train is permitted to enter a block section without first obtaining a tangible right to do so, in the form of a staff or tablet which is in effect a metal train order.

The Southern Pacific main line over the Sierras from Colfax to Truckee is operated under the electric train staff system.

It remained, however, for the inventive American to devise and develop the highest type of block signaling, namely the "automatic system" in which the block signals are directly controlled by the presence or absence of trains in their respective block sections.

Thomas S. Hall of Hartford, Conn., was, as far as can be determined, the first man to install automatic block signals, having placed some in operation on the N. Y. N. H. & H. in 1866 or 67. These were of the disc type and operated by track instruments which were struck by the wheels of passing trains.

The "track circuit" was invented by William Robinson and Franklin L. Pope, the latter of whom installed the first one on the Boston & Lowell R. R. in 1871. At the Centennial Exhibition in 1876 Mr. Pope exhibited a track circuit working under water, as a practical demonstration of its ability to operate under unfavorable ballast conditions.

For over twenty years opinion was divided between engineers as to the comparative merits of track instruments and track circuits for the operation of automatic signals on steam railroads. While it was generally admitted that the continuous track circuit was theoretically the ideal method, yet owing to the practical difficulties encountered in the early stages of the art, many engineers felt that track instrument control was the more reliable of the two.

With improvements in track ballast, drainage and methods of installation, and particularly because of larger and more efficient track relays, the track circuit method gradually out-distanced its competitor and since about 1895 has been the only recognized method of automatic control on steam railroads.

It is interesting to note that to a certain extent history is now repeating itself on electric railroads, where numerous devices in the shape of track and trolley instruments are being offered as substitutes for continuous track circuit.

As a general proposition, however, the management of most electric railroads using automatic block signals fully realize the advantages of the alternating current track circuit and it is being rapidly introduced and extended on such lines.

The a.c. track circuit was invented by J. B. Struble in 1901 and the first installation was made on the North Shore Railroad between Sausalito and San Anselmo in 1903.

In the early days of automatic signaling two types of signals were employed, the enclosed disc and the rotating banner.

The first consisted of a banjo shaped head within which a red disc and light were displayed to indicate "stop" and a green or white disc and light to indicate "clear." The disc and colored glasses were mounted on a pivot and operated directly by electro magnets, the current being supplied by gravity batteries. This signal, as is obvious, displayed both its night and day indications by changes of color entirely.

The rotating banner signal had a banner of special form and a four lens lamp mounted on a vertical shaft in the same manner as a switch target which shaft was rotated 90 degrees at each movement by clockwork, the power being furnished by a weight within the signal post which was wound up about once a week.

The control was by means of electro magnets and gravity batteries and the signal is noteworthy as requiring less electrical energy for its operation than any before or since designed. At a test made in Boston the signal was operated a number of times by one cell of gravity battery, the elements of which were contained in a five-cent ink bottle.

The first semaphore to be used for automatic signaling was of the electro-pneumatic type installed on the Fitchburgh Railroad in 1883.

In the three automatic signals just mentioned the mechanisms were all placed as closely to the signal arm they operated as possible, and hence were what is now technically known as "top mast" signals. Such a signal requires that the maintainer climb the ladder to inspect or repair a mechanism, and to overcome this objection the electro pneumatic signal was redesigned in 1893, and its mechanism placed at the base on the post, the connections between the mechanisms and blades being run inside the post itself. This is now shown as a bottom post signal.

Semaphores operated solely by electric means had been used by Taylor, Ramsey, Weir and Lattig in their electric interlockings, but none had been applied to automatic purposes to any extent, if at all, until J. P. Coleman brought out his first electric semaphore in 1897.

In designing this signal to compete as closely as possible in first cost and in cost of operation with the disc and banner types then most commonly used, without sacrificing safety, Mr. Coleman enclosed all the moving parts except the spectacle and blade, provided roller bearings wherever practicable, and generally reduced the power required for its operation to a minimum. He placed the mechanism in a case at the base of the signal at a convenient height from the ground for inspection and adjustment.

Many of the ideas contained in this design have been embodied in the present types of electric semaphores, of which there are upwards of 75,000 in service today.

Within the last five years the original top-mast idea has been applied to several designs of electric semaphores, and today there are a number in successful operation.

Since its first introduction to this country, the "clear" and "caution" indications of practically all semaphore signals were displayed by depressing the arm below the horizontal and providing an artificial counterweight for restoring it to the horizontal or "stop" position by gravity. In recent years, however, it has become the general practice on a number of railroads to incline the blade upwardly for the "caution" and "clear" indications, which has been the practice in Germany for many years. The main advantage of this is that the blade becomes its own counterweight and any accumulation of sleet and snow will assist in restoring it to the "stop" position instead of retarding its return, as in the "lower quadrant" type.

The practice of using signals displaying three distinct indications with one arm and light has grown considerably in favor of late years.

ELECTRIC FIRING OF SHOTS.

As a result of efforts to make the firing of shots in coal mines safer, systems of firing by electricity have been developed. These systems, in the best practice, require that all men shall be out of the mine before any shots are fired. The essential features of a good electrical firing system, according to information just compiled by the Bureau of Mines, are as follows:

The mine is wired with rubber-covered wires laid in parallel in order that one defective shot may not prevent others from being fired. On the main entries No. 6 rubber-covered wire is used, on the cross entries No. 10 or No. 12, and in the rooms No. 14 wire. These wires are hung from props or from plugs set in the roof. At the mouth of each cross entry there is placed a locked box in which there is a single-pole double-throw switch that is arranged to open downward to avoid accidental contact by falling. A similar, though smaller, switch is in some mines placed at the mouth of each room, or else the room wire is connected to the wire on the cross entry without the use of a switch. At the mouth of the mine there is a shot-firing cabin in which a 100-ampere, two-pole, single-throw switch is placed. There is a similar switch of the same size in the power house. This plan insures that there shall always be at least three open switches between the mine and the power house when the shot is being connected up. Fig. 1 illustrates the arrangement of shot-firing wires in a mine room.

The operation of the system is as follows: Every employe in the mine is given a brass check with his number stamped upon it. Upon entering the mine he hangs his check upon a check board in the shot-firing cabin. This board has painted upon it numbers which correspond to the numbers on the checks, and each check is hung over the proper number. No one is allowed to enter the mine unless he has previously hung up his check on the check board.

Usually the miners are allwed a certain maximum number of shots for each working place—generally three. The coal is undercut in most places, and permissible explosives are used. Special shot firers go through the mine during the day examining the shots as they are being prepared by the miner and distributing the electric detonators. In some instances the miner tamps the shots himself; in others the shots are tamped by the special shot firers. If the miner tamps the shots, he connects the detonator legs sticking out of the shot hole to the No. 14 wire, which extends up

the roadway of the room, notes that the connection at the room mouth is made, and then leaves the mine. In connecting the detonator legs to the No. 14 wire care is taken to strip the insulation off the lead wires and to wrap the legs around the No. 14 wire, not looping them, as is done in some mines.

After all the miners have left the mine the shot firer goes through each entry and notes that the switch at the mouth of each room is closed or that the connection is made at the room mouth if the switch is not used. At the mouth of each cross entry he unlocks the

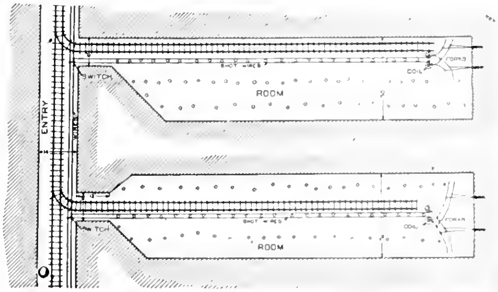


Fig. 1. Proper Arrangement of Shot-Firing Wires in Mine Room.

switch box, throws in the switch, and locks the box. He then proceeds to the mouth of the mine, enters the shot-firing cabin, and notes that all the checks have been taken off the board, which signifies that the check owners have left the mine. If any checks are still remaining on the board, he searches the mine until the men represented by the checks are found, or if any miner has left the mine without taking his check with him this fact is determined. Usually there is a fine provided for failure to leave or take away a check at the proper time.

When the shot firer has ascertained that all the checks have been taken from the board, he then goes to the power house, where there is a switch provided, and generally an electric generator giving direct current of about 500 volts, to fire the shots. The shot firer instructs the man in the power house to throw in the power house switch and then returns to his own cabin, unlocks the switch box there, and throws in the switch, thus firing all the shots in the mine. After the shots have been fired, the shot firer opens the switch and locks the box.

There are always some misfires, caused by carelessness in making connections, by falls of roof deranging the wires, or by projecting portions of the roof cutting the insulation off the wires. The fire boss goes into the mine about an hour after the shots have been fired and unlocks each box, throws out the switch, and locks the box again. He then proceeds to each working place, notes what shots failed to go off, and connects them up properly. When he leaves the mine at the close of his shift he unlocks each box, throws in the switches, and fires the shots just as a shot firer on a day shift would do. By this procedure the number of failures is reduced to a minimum. The average proportion of failures is said to be about one-half of 1 per cent, or about one failure to every 200 shots.

Fig. 2 shows a plan of mine workings wired for such a method of electrical firing.

The cost of equipping a mine for firing shots by the method above outlined varies from $1000 to $3000, depending upon the size of the mine. The maintenance and operation of the system is said to cost from 1 to 3 cents per ton. It has been used successfully for some time past in some coal fields, and its adoption in other fields, when permitted by local conditions, would reduce accidents in coal mines.

THE ELECTRICAL INDUSTRY AND TRADE IN GREAT BRITAIN.

Last year the electrical industry experienced a large measure of prosperity in the United Kingdom, so far as the output was concerned, but it is claimed that price cutting was so general and severe that the returns from dynamos and motors fell to a point where they could not be sold at a profit. As a result of the recent coal strike, attention has been widely directed to the use of electricity for motive power, lighting, cooking, etc. The manager of one of the electric companies in London stated recently that his company had orders for nine months ahead for motors, which would tax the full capacity of its works. The electrification of railways was carried on to a greater extent in 1911 than in the preceding year, especially in London and the north of England.

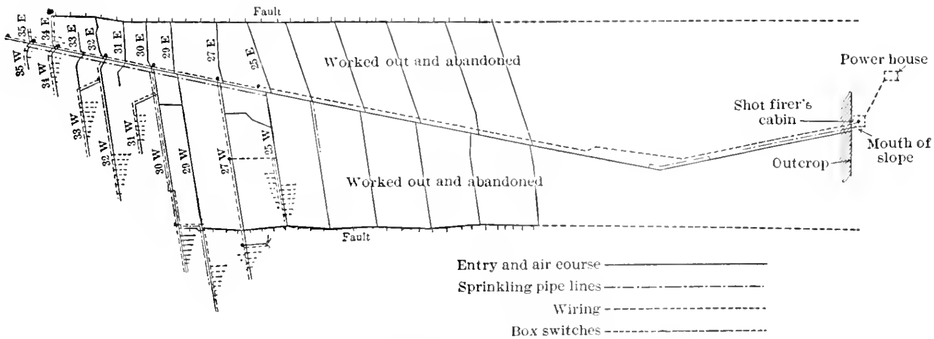


Fig. 2. Plan of Mine Workings Wired for Electrical Firing.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

San Francisco In 1915

The Golden Poppy Special leaves tonight for the great convention of the National Electric Light Association. Throughout the week eastern visitors have been experiencing the exhilarating effects of western enterprise and hospitality. The move for the next two days will be concentrated upon Seattle. Never before has the West shown such united force in boosting an electrical convention.

Strength be to her strong right arm during the next week! May she consummate with characteristic efficiency a task labored for so long!

The West feels justified in asking the Seattle convention for a second visit from her eastern brothers. This time a world triumph in engineering will be celebrated. In a word, the Golden Poppy Special goes north, bedecked with its thousands of golden poppies, prepared to pop a definite question to the National Electric Light Association in convention assembled—and no other answer will be taken but "we'll come to San Francisco in 1915."

Convention Papers

Since the days of long ago, when Archimedes announced that he could move the world with his lever, engineers have recognized that the strength of a lever or beam varied with the breadth of cross-section in the material employed. They have known that its depth in cross-section was also a factor in the strength attained and that this strength increased in a greater proportion than similar increase in breadth. Indeed, careful modern mathematical investigation has shown conclusively that while a beam increases in strength directly with breadth, by doubling the depth, its strength is increased fourfold.

Thorough discussion is the modern lever that moves a world of engineering thought. The papers to be presented at the Seattle convention discuss subjects of the most interesting and vital nature to the electric lighting industry. These papers, presented by the greatest living authorities in each particular subject, represent the last word of advance yet accomplished. Within the hearing of the readers will be men of national experience, pre-eminently qualified to discuss with force and vigor. Breadth of view should indeed be seen on all sides, but above all depth should not be forgotten.

The enormous strides taken in the electric lighting industry in recent years have made it beyond human power for a single individual to master the subject in all its various ramifications. The importance of carefully filed papers and discussions on vital topics is made manifest from the experiences each day encountered by those engaged in the art. No longer do we consider the publishing broadcast of results attained by years of faithful study and investigaion as a possible placing of weapons in the hands of our competitors. The old world has grown too big and too broad for such narrow-minded views. The dark and murky den of the alchemist of the middle ages presents a vivid picture of the stagnation sure to result from such narrow-minded practice.

In the grinding out of our national supply of electric power for lighting there is used every mechanism

known to human invention. The brains of our great commercial engineers play no insignificant part in the onward trend of affairs electrical. It takes little stretch of imagination to picture the inner workings of our modern intellectual talent as being analogous to a complete and highly efficient modern power plant wherein smoothly running cams, gears, ratchets and levers convert fleeting mental inspirations into full-blown practical ideas for the advance of the industry. Careful and earnest discussion may be likened to levers which put ideas into harmonious action.

It is to be hoped that all qualified to speak will not hesitate to do so and that the discussion may proceed with vim and vigor. Thus, with discussion duly proportioned in breadth and depth by men of pre-eminent attainments in the questions at issue, this modern lever should in truth move a world of engineering thought. When thus properly constructed let us then rest this lever upon its fulcrum—the National Electric Light Association—and the lighting industry will move ahead as it is wont to do by leaps and bounds.

British Engineering Activities in China

Some weeks ago editorial comment was made in these columns relative to the engineering opportunities immediately ahead in China for Western engineers. Indeed, the re-awakening of China and its gigantic possibilities form no mean asset to the great cities on the western slope of America. That the energies of our engineering brothers in the British Isles are to be at once concentrated upon China in an effort to cut off from us our natural birthright is clearly shown in an excerpt appearing on another page under the heading of British Engineering Activity in China.

Engineers of the Pacific Coast States and Western Canada have been so engrossed in building an empire within, time to look out over the seas to add to our engineering accomplishments has indeed been scant. It is but natural to believe that, due to their favored location, western sea port cities, equipped with every modern convenience, are in a position to command a respectful hearing in competitive commercial activity soon to be brought about in the completion of the Panama Canal.

In this readjustment of the world's commerce new empires and new industrial centers will be formed. The favored situation of the western slope of America, constituting in a measure a center of gravity between the old and the new, should make this locality the stage upon which many of the engineering feats of these new empires are to be acted.

Such a realization have more than one precedent, as can be easily verified by reference to history. In the thirteenth and fourteenth centuries, the reawakening of Western Europe and reopened activities with Western Asia made the central cities—Venice, Naples, Florence and others—world powers in transporting this world activity from the east to the west and from the west to the east. Indeed, returning to the situation in the new west, long since, Seward has said the Pacific Ocean, its shores, its islands and the vast regions beyond, will become the chief theater of events in the world's great hereafter.

Immediately to our west, situated on the same waters that lap our shores, one-third of the population of the globe is located. The Puget Sound, the Columbia River, the San Francisco Bay, San Pedro and San Diego harbors will soon have a great work in bearing burdens to this vast empire across the seas. No insignificant part of this burden should be that of transporting our just share of brains and talent to aid in this great work. It behooves our engineering firms, then—both designing and industrial—to get busy in planning a competitive campaign to meet that already inaugurated by our British cousins in China.

The Engineer and Constructive Citizenship

In our issue of Dec. 2, 1911, there was published an article by the late Richard T. Crane on The Futility of Technical Schools. We took occasion at that time to comment editorially on the many unjust and harsh criticisms made by Mr. Crane.

Elsewhere in these columns will be found the graduating address on the Relation of the Engineer to Constructive Citizenship, by Lester S. Ready who recently received his degree from the college of mechanical engineering at the University of California and who was awarded the class medal as being the most distinguished student of a class of 679 receiving their diplomas. The ideas of this young man are interesting to engineers and embody, in a measure, a complete answer to the shallow arguments put forth by Mr. Crane. Indeed all of the criticism put forth by the late founder of Crane & Co. smelled so of the dollar and cent valuation that many were prone to cast aside the criticism without going further, but now in these views of the young technical graduate so ably expressed, the keen observer notes at a glance that citizenship—the prime reason for the state's investing enormous sums in the technical training of the young —is being immeasurably heightened.

The technical institutions of the West will for the next month continue to pour forth their engineering graduates into the broiling sea of commercial life. The able leaders of engineering in this vast western domain are fast beginning to acknowledge the prowess of high ideals here imbued, and the peculiar fitness of her sons to grapple with western problems. The first of these institutions to hold its commencement thus far this year was the University of California. Although a record-breaking class has just graduated from the mechanical and electrical engineering department, over ninety per cent of these young men have already found technical positions in spite of the fact that only ten days have elapsed since their graduation. Undoubtedly by the great engineering corporations the same hungry search for capable energetic men will be made among the Stanford graduates, those of Washington, Oregon and other western institutions.

The Journal offers the heartiest congratulations to these young engineers and trusts that they will never swerve from their high public trust—that of raising to the highest standard of excellence possible, the relation of the engineer to constructive citizenship.

PERSONALS.

C. R. Dederick, an electrical supply dealer of Portland, was at San Francisco this week.

Rudolph W. Van Norden, consulting engineer at San Francisco, has returned from Fresno.

H. R. Noack, president of Pierson, Roeding & Company, has returned to San Francisco from Los Angeles.

Robert Sibley, editor of the Journal of Electricity, Power and Gas, has returned to San Francisco from Santa Cruz.

Thomas Mirk of the firm of Hunt, Mirk & Co. spent the past week at Los Angeles and San Diego on engineering business.

C. O. Poole, of the firm of Manifold & Poole, electrical engineers of Los Angeles, spent a few days at San Francisco during the past week.

F. F. Skeel, manager of the Crouse-Hinds Company, returned to San Francisco during the past week, after visiting Los Angeles on business.

H. A. Hughes, formerly with the Pittsburg office, has joined the sales corps of the Westinghouse Electric & Manufacturing Company's San Francisco office.

Frank H. Gale, in charge of advertising for the General Electric Company, was at San Francisco this week from Schenectady, leaving for Seattle on Friday night.

Frank Connell, head of the Skinner Engine Company, of Erie, Pa., spent the past week at San Francisco, where he came to meet his family on their return from the Orient.

J. G. Blake, general superintendent of the Postal Telegraph Cable Company, with headquarters at San Francisco, is at New York with the intention of spending six weeks in the East.

E. W. Bannister, formerly assistant engineer on the Los Angeles Aqueduct, has been appointed sales engineer for the Aqueduct Advisory Board, selling surplus equipment and materials.

C. W. Waller, a successful promoter of electric power enterprises, has returned from a European trip and is again making his headquarters in the Alaska Commercial Building, San Francisco.

Alvah K. Lowrie, one of the directors of the Aluminum Company of America, recently visited the San Francisco office of Pierson, Roeding & Co., while en route from the Orient to his home in the East.

G. M. Robertson, engineer of the Board of Fire Underwriters of the Pacific, has returned to San Francisco after a trip to Chicago, where he was elected vice-president of the National Fire Protective Association.

O. M. Rau, general manager of the Commonwealth Power Company of Milwaukee, Wis., is at Los Angeles, with Mrs. Rau and will go to Seattle during the coming week to attend the annual convention of the N. E. L. A.

Leslie F. Curtiss, formerly with the General Electric Company at Schenectady, N. Y., and a graduate of Tuft's College, in the class of 1910, has been appointed instructor in electrical engineering at the University of Washington, Seattle.

Clarence Cory Harshman, nephew of C. L. Cory of San Francisco, shipped aboard the Manchuria on last Thursday as a fireman. The young apprentice will return from China in time to assume his studies at the University of California in the fall.

M. F. Steele, of the sales force of F. H. Poss, Pacific Coast agent for the Benjamin Electric Company, spent the past week at Seattle, installing an exhibit of Benjamin electrical materials at the National Electric Light Association convention hall.

Chas. R. Rall, secretary and treasurer of the Pittsburg Piping & Equipment Company, has returned to Pittsburg after spending two weeks in California with Theo F. Dredge, Pacific Coast representative for the company.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, has returned from Milwaukee and will spend a week or two at the San Francisco office of the company on business connected with hydroelectric contracts to be let in California.

Harold W. Cope, assistant manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company, of East Pittsburg visited the district offices at Los Angeles during the past week on his way to the N. E. L. A. convention at Seattle.

T. E. Bibbins, local manager of the General Electric Company's San Francisco office, and **E. O. Shreve,** sales manager with the company, accompanied the Red Special to the N. E. L. A. convention as far as Los Angeles, whence they came directly to San Francisco.

S. P. Russell, manager of the electrical supply department of the H. W. Johns-Manville Company's San Francisco house, is spending two weeks at the Presidio on duty at the militia encampment. He is first lieutenant of the Sixth Company of the Coast Artillery, N. G. C.

Joseph B. Kahn, superintendent of the municipal electricity department of Alameda, is preparing plans for a new fireproof power-house building for the steam plant, which is to be doubled in capacity by the installation of additional engines and generators at an estimated cost of $110,000.

William Nixon, chief of the department of electricity of San Francisco, addressed the Downtown Committee of the Chamber of Commerce at their weekly luncheon last Wednesday. He explained the operation of the city's fire alarm telegraph system and described the electrical inspection methods of his department.

W. C. Baker, of Salt Lake City, formerly assistant to the superintendent of the electrical railway system of that city, has been appointed superintendent of the Yakima division of the Oregon-Washington Railroad & Navigation Company, and of the Yakima Valley Transportation Company and electric lines owned by the Harriman interests.

Hans von Schulthess, consulting engineer of Zurich, Switzerland, is investigating and reporting upon Pacific Coast hydroelectric plants in the course of an American trip in the interest of Swiss financiers. He has already visited several of the properties in Southern and Central California, and expects to proceed to Seattle on the Golden Poppy Special.

J. H. Pardee, vice-president and manager of the operating department of J. G. White & Company of New York, arrived from the East and spent several days at San Francisco before departing for Seattle to attend the National Electric Light Association's annual convention. He was accompanied by C. F. Conn, assistant manager of the firm's San Francisco office, when he went north.

C. W. Larner, representing the Wellman, Seaver, Morgan Company, of Cleveland, is among the representatives of eastern water wheel manufacturers who are at San Francisco conferring with the management of the Great Western Power Company regarding the details for their proposed 35,000 h.p. water wheel for the additional generating unit that is to be installed in the extension of the power station at Big Bend.

The delegates to the Seattle convention of the National Electric Light Association who spent the past week in California en route from Boston and New York City on the Red Special were as follows: J. R. Crouse and wife, National Quality Lamp Division of General Electric Company; H. A. Tremaine and wife, National Quality Lamp Division of General Electric Company; Ray D. Lillibridge, Wagner Electric Manufacturing Company; F. M. Tait and wife, The Dayton Power & Light Company; Charles Wuichet and wife, The Dayton Power & Light Company; A. E. Carrier and wife, National Carbon Company; H. B. Logan and wife, Dossert & Company; R. W. Charles and wife, Otis Elevator Company; T. E. Murray and wife, N. Y. Edison Company; John W. Lieb, Jr., and wife, N. Y. Edison Company; John R. Graham and wife, Bangor Railway & Electric Company; Miss Julia Engler, Miss Graham; Arthur Williams, N. Y. Edison Company; S. C. D. Johns and wife, Cleveland Electric Illuminating Company; E. J. Bechtel and wife, Hodenpyl, Hardy Company; T. Beran and wife, General Electric Company; George W. Elliott and wife, Electrical World; Chas. H. Hodskinson and wife, Edison Electric Illuminating Company; G. T. Hanson, Okonite Company; Leslie C. Love; J. W. Howell and wife, General Electric Company; D. C. Shain and wife, Scranton Electric Company; George W. Higgins and wife, New York Central Lines; J. B. Seaman, The Philadelphia Electric Company; B. Frank Day, The Philadelphia Electric Company; R. S. Hale, Edison Electric Illuminating Company; S. G. Rhodes and wife, New York Edison Company; S. E. Doane, National Quality Lamp Division of General Electric Company; E. W. Lloyd and wife, Commonwealth Edison Company; Arthur B. Huey and wife, The Philadelphia Electric Company; J. B. McCall and wife, The Philadelphia Electric Company; C. L. Bundy and wife, Philadelphia Electrical & Manufacturing Company; A. H. Manwaring and wife, The Philadelphia Electric Company; H. T. Paiste and wife, H. T. Paiste Company; Norman MacBeth and wife, illuminating engineer; F. W. Sanford, General Electric Company; J. O. Montignani, Rochester Railway & Light Company; T. H. Yawger, Rochester Railway & Light Company; A. Parshall, Ellenville Electric Company; Stuart Wilder, Westchester Lighting Company; W. E. G. Mitchell, Mitchell-Rand Company; H. Inches, Blodgett & Company; Newton W. Leidy, N. Y. Edison Company; W. W. Freeman, Edison Electric Illuminating Company; T. I. Jones, Edison Electric Illuminating Company; Charles Horstman, United Electric Light & Power Company; Miss Marie Horstman; A. A. Brown, Westinghouse Electric & Manufacturing Company; W. S. Rugg, Westinghouse Electric & Manufacturing Company; T. J. Place, Westinghouse Electric & Manufacturing Company; Phillip S. Dodd and wife, National Quality Lamp Division of General Electric Company; A. W. Hellis, The Westinghouse Machine Company; E. C. Brown, Dearborn Drug & Chemical Works; M. M. Eckhardt, Derby Gas Company; J. Brodie Smith and wife, Manchester Traction, Light & Power Company; Daniel Goss and D. C. Goss, Edison Electric Illuminating Company; F. J. Whitting and wife, Stone & Webster; Charles B. Burleigh and wife, General Electric Company; W. R. Eaton and wife, Cambridge Electric Light Company; James I. Ayer and wife, Simplex Electric Heating Company; Geo. R. Stetson and wife, New Bedford Gas & Edison Light Company; W. J. Keenan and wife, Pettingill-Andrews Company; A. M. Barnes and wife, Cambridge Gas Light Company; D. W. Low of Otis & Hough.

NEW CATALOGUES.

Fancleve Specialty Company have published a new catalogue of electric fittings.

Bulletin No. 136 from the Electric Storage Battery Company is concerned with the development and use of Storage Battery Railway Cars.

Sprague Electric Works of the General Electric Company have issued a neat descriptive pamphlet and price list of Greenfieldnct, their new galvanized conduit.

H. W. Johns-Manville Company have issued an interesting pamphlet on the Audifren-Singrun refrigerating machine requiring from ½ to 4 h.p. and forming an ideal load for central stations.

Circular 1194, issued by the Westinghouse Electric & Manufacturing Company, cover Type Q direct current engine driven generators, and describes their construction very fully as well as illustrating the various parts.

The Electric Storage Battery Company has prepared a blue print map of the United States showing the location of their sales offices, depots, construction and operating branches, and inspectors. This exhibits to a remarkable degree this company's claim of a superior service organization.

For the purpose of encouraging the use of "Sunbeam Mazda" lamps, an attractive booklet entitled "Advertising Sunbeam Mazda Lamps in Newspapers" has been prepared for distribution by the Western Electric Company. In it will be found numerous suggestions for advertising copy and appropriate black and white illustrations.

The General Electric Company has just issued Bulletin No. 4939, which is descriptive of Electric Hoists manufactured by that company. Bulletin 4947, is devoted to the illumination of electric railway cars and the advantages possessed by Edison Mazda and Gem lamps for this service. The extent to which electric drive is being applied to the shoe and leather industry, and the advantages to be derived from this application, are shown in Bulletin No. 4931, which contains illustrations and descriptions of various installations of this nature.

A series of intimate views of the Hawthorne works of the Western Electric Company has recently been arranged for post card use and is intended to give the company's friends a better idea of what the "Electrical Capital of America" really is and what is being done there, industrially and socially. The series consist of twelve views showing a general view of the works, the imposing water tower, the telephone apparatus shops, the general merchandise warehouse, the interior of the lead press room in the cable plant, a view showing how cable cores are built up, a corner of the switchboard department, the cord department, an electric motor truck in the warehouse, the brass band which makes good music as well as "quality apparatus," the lunch room with a seating capacity of 3000 and one of the annual field day events of the athletic association.

The Westinghouse Electric & Manufacturing Company has recently issued the following descriptive leaflets describing the various forms of apparatus mentioned below: 2303, Direct Current Crane Motors, detailed and completed views being shown. 2313, No. 907 Commutating Pole Mine Motors. 2314, No 909 Commutating Pole Mine Motors. 2315, No. 910 Commutating Pole Mine Motors. 2464, Type HD Rheostats for d.c. Motors. 2377, Box Frame Interpole Railway Motor No. 308 B-2 for locomotive work. 2376, Box Frame Interpole Railway Motor No. 321 for use on 600-1200-volt service. 2370, Covers various details of railway motors such as bearings, brushholders, commutators, field coils, etc. 2368, Strap Wound Armature Coils of Westinghouse Railway Motors. This leaflet contains a reprint from the Electric Railway Journal on the subject of "Square Wire or Strap Copper Construction." 2444, Equalizer Fly Wheel Hoisting Sets. This leaflet shows application and diagramatic views of these sets and full explanation of their method of operation. 2393, Covers Westinghouse Dynamotor Compressor for 1200-1500 Volt Direct Current Service.

ELECTRICAL JOBBERS AT DEL MONTE.

The electrical snpply jobbers of the Pacific Coast met at Del Monte, Cal., May 30 and 31, 1912. In addition to the usual games of golf and pool an innovation was introduced in the way of "Del Monte Carlo," large sums of "stage" money being risked on the turn of the roulette wheel and the antics of the dice. The prize winners were W. L. Goodwin, Garnett Young and S. P. Russell, of the gentlemen, and Mrs. C. C. Hillis and Mrs. J. A. Herr of the ladies.

The scores in the golf tournament were as follows:

Manufacturers.
(Competing for Jobbers' Cup.)

	Gross.	Hdc.	Net
S. B. Gregory	105	—12	93
*R. F. Oakes	108	—27	81
F. H. Poss	119	—13	106
H. E. Sanderson	97	+7	104
W. H. Seaver	121	—27	94
Garnett Young	125	—27	98
F. F. Skeel	118	—27	91

* Winner.

Jobbers' Cup and Patton Cup.

	Gross.	Hdc.	Net
W. S. Berry	108	+16	124
Theo. Burger	121	—11	110
H. V. Carter	107	—3	104
C. R. Dederick	120	—13	107
A. H. Elliott	130	—6	124
F. B. Gleason	109	+6	115
W. L. Goodwin	103	+13	116
*C. C. Hillis	94	+7	101

* Winner.

The Everready Cup was won by Col. H. V. Carter and the Seaver Cup for low gross score by H. E. Sanderson. Mrs. C. C. Hillis won the ladies' cup offered by the Journal of Electricity.

The Pool tournament was won by W. L. Goodwin who defeated R. D. Holabird in the finals.

Those in attendance were:

Jobbers.

R. D. Holabird	H. V. Carter	Albert H. Elliott
W. L. Goodwin and wife	F. B. Gleason	C. L. Gilson
Frank Fowden	C. E. Wiggin	C. C. Hillis, wife and two children
F. V. Averill	C. E. Dederick	
T. E. Burger	W. I. Berry and wife	

Manufacturers.

S. E. Sanderson	Roscoe Oakes	S. P. Russell
S. B. Gregory	W. H. Seaver	J. A. Herr
Garnet Young		

INTERNATIONAL ELECTRICAL CONGRESS, SAN FRANCISCO, 1915.

Gano Dunn, president of the American Institute of Electrical Engineers, has announced the appointment of the following members of the Committee on Organization of the International Electrical Congress at San Francisco in 1915:

Charles P. Steinmetz ....President.
Arthur E. Kennelly ....Vice-President on Program.
C. O. Mailloux ....Vice-President on International Relations.
W. D. Weaver ....Vice-President on Organization.
Henry A. Lardner ....Vice-President on Pacific Coast Relations.
Edward B. Rosa ....Secretary.
Preston S. Millar ....Treasurer and Business Manager.

(The above officers constitute the Executive Committee).

Representative Members.

American Electric Railway Association.
Henry W. Blake, Frank R. Ford,
Edwin B. Katte, Henry G. Stott.

American Electrochemical Society.
Charles A. Doremus, Carl Hering,
Willis R. Whitney.

American Physical Society.
Frederick Bedell, Charles F. Burgess,
Edward L. Nichols.

Association Edison Illuminating Companies.
Alex Dow, Louis A. Ferguson,
John W. Lieb, Jr., Joseph B. McCall.

Association of Railway Electrical Engineers.
Jesse H. Davis, Charles R. Sugg.

Association Iron and Steel Electrical Engineers.
Eugene Friedlander, Barton R. Shover.

Alabama Light and Traction Association.
(Names to be announced later.)

Colorado Electric Light, Power and Railway Association.
John F. Dostal, Franklin P. Wood.

Electrical Vehicle Associaton of America.
William H. Blood, Jr., Frank W. Smith,
Philip D. Wagoner.

Empire State Gas and Electric Association.
Charles R. Huntley, Robert Meredith Searle.

Florida Electric Light and Power Associaton.
(Names to be announced later.)

Illinois Electrical Association.
Ernst Julius Berg, Francis Marion Sinsabaugh.

Illuminating Engineerng Society.
Edwin Pechin Hyde, Van Ransselaer Lansingh,
Louis B. Marks, Addams Stratton McAllister.

Indiana Electric Light Association.
William D. Ray.

International Association Municipal Electric.
William Brophy, Walter M. Petty.

Iowa Electrical Association.
Arthur Hillyer Ford, Louis Bevier Spinney,

Louisiana Electrical Association.
(Names to be announced later.)

Maine Electrical Association.
Henry Wilson Eells, Walter Kierstead Ganong.

Minnesota Electrical Association.
Paul Doty, Henry John Gille,
George D. Shepardson.

Missouri Electric, Gas and Street Railway and Water Association.
(Names to be announced later.)

National Bureau of Standards.
Samuel W. Stratton.

National Electrical Contractors' Association.
(Names to be announced later.)

National Electric Light Association.
Frank Rutter Daniel, Hugh T. Wreaks.

National Electrical Light Association.
Charles L. Edgar, Weldon W. Freeman,
Frank W. Frueauff, John F. Gilchrist,
Samuel Insull, T. C. Martin,
Arthur Williams.

New York Electrical Society.
Henry L. Doherty, George Hell Guy.

Electrical Testing Laboratories.
Clayton H. Sharp.

Franklin Institute.
William C. L. Eglin, Robert Bowie Owens.

Ohio Electric Light Association.
Francis Cary Caldwell, Frank Morrison Tait.

Society for Promotion of Engineering Education.
Henry Hutchinson Norris, Samuel Sheldon.

Institute of Radio Engineers.
John L. Hogan, Jr.

Southwestern Electrical and Gas Association.
Fred Marion Lege, Jr., Arthur Curtis Scott.

Vermont Electrical Association.
(Names to be announced later.)

Western Society of Engineers.
William L. Abbott, Harold Almert.

Wisconsin Electrical Association.
Philip Harold Korst, Roy Henry Pinkley.
(List not complete.)

Pacific Coast Members.

San Francisco.

Allen H. Babcock,	George R. Murphy,
Frank G. Baum,	Fred F. Barbour,
Augustus J. Bowie, Jr.,	Charles N. Black,
Charles W. Burkett,	Wallace W. Briggs,
Harold W. Clapp,	Samuel B. Charters,
Clarence L. Cory,	Safford K. Colby,
W. J. Davis, Jr.,	Herbert W. Crozier,
P. M. Downing,	W. F. Durand,
Arthur H. Halloran,	Augustus H. Griswold,
George J. Henry, Jr.,	William W. Hanscom,
Andrew Murray Hunt,	George C. Holberton,
S. L. Griswold Knox,	Sylvan J. Lisberger,
Sam L. Naphtaly,	Wynn Meredith,
Robert Sibley,	Earl O. Shreve,
Sidney Sprout,	Harris J. Ryan,
Rudolph W. Van Norden,	Frank H. Varney.
J. E. Woodbridge.	

Los Angeles.

Henry S. Carhart,	J. E. Macdonald,
Edwin R. Davis,	George A. Damon,
James A. Lighthipe,	Orville Hiram Ensign,
Henry H. Sinclair,	Ezra F. Scattergood,
E. R. Northmore.	

Portland.

Orin B. Coldwell,	W. D. Scott,
James A. Cranston,	Leroy B. Cramer,
Paul Lebenbaum,	Glen E. Kibbe,
W. S. Turner,	Henry R. Wakeman,
F. D. Weber.	

Seattle.

Magnus T. Crawford,	Alvin A. Miller,
Edgar Loew,	John Harisberger,
Carl E. Magnusson.	

Spokane.

John B. Fisken,	D. L. Huntington,
Robert Howes.	

Corvallis.

William A. Hillebrand.

Vancouver, B. C.

F. D. Nims,	E. M. Breed,
	Robert F. Hayward.

Members at Large.

Comfort A. Adams,	Bion J. Arnold,
Howel H. Barnes, Jr.,	Bernard A. Behrend,
Louis Bell,	Charles F. Brush,
Harold W. Buck,	John J. Carty,
Alfred H. Cowles,	Francis B. Crocker,
Samuel E. Doane,	Louis Duncan,
Thomas A. Edison,	Reginald A. Fessenden,
John H. Finney,	W. S. Franklin,
Bancroft Gherardi,	Lester W. Gill,
Winder E. Goldsborough,	L. A. Herdt,
Peter Cooper Hewitt,	John W. Howell,
Henry H. Humphrey,	Cary T. Hutchinson,
Dugald C. Jackson,	Peter Junkersfeld,
Benjamin G. Lamme,	Alexander S. Langsdorf,
William A. Layman,	William S. Lee,
Paul M. Lincoln,	Samuel G. McMeen,
Ralph D. Mershon,	P. N. Nunn,
W. B. Potter,	Michael I. Pupin,
Samuel Reber,	Calvin W. Rice,
E. Wilbur Rice, Jr.,	David B. Rushmore,
A. M. Schoen,	Charles F. Scott,
Charles E. Scribner,	George F. Sever,
Peter William Sothman,	Frank J. Sprague,
G. O. Squier,	William Stanley,
Louis B. Stillwell,	Charles Waterman Stone,
Charles A. Terry,	Elihu Thomson,
George Westinghouse,	Edward Weston,
Scuyler S. Wheeler,	James G. White,

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION

The Butte Engineering & Electric Company have been awarded the wiring contract for the 15-story building of the Sierra Investment Company at Stockton street and Grant avenue, at about $4500.

The John G. Sutton Company have been given a contract by the same company for a 7-story apartment house at Market and Brady streets, at $5000.

The Decher Electric Construction Company are doing the electric work in the new home of the Great Western Power Company on Post street.

The General Electric Cons ruction Company have been awarded the wiring for the London, Liverpool & Globe Insurance Company's new building on California street.

E. V. Burkhard, the Palo Alto contractor, was in town last Monday.

Billboard displays show that the Pacific Gas & Electric Company and the Electrical Contractors' Association have joined hands in seeking new business.

A real game of baseball on a real diamond for a cup is one of the many attractions to be furnished for the amusement of the Contractors' Convention. Team captains are out after talent and it is rumored that Baseball Manager Boynton has secured a battery that will go to the big league as soon as the game is over.

Don't forget the date July 24-25-26-27.

The advance squadrons of boosters for the Contractors' Convention made a flying trip down the peninsula Sunday. Through the kindness of Messrs. Waldron, Murman, Butte, Levy and Turner, five large autos were filled with members of San Francisco Local No. 1, and an early start was made. Large signs on the rear of each car announced the mission of the party. Secretary Hanbridge provided a lunch at the St. James Hotel in San Jose, which has been selected as convention headquarters. Luna Park was selected for the picnic ground. The members of the committee who went on the trip were: C. F. Butte, Dave Turner, Russ Waldron, N. Hope, L. Levy, W. S. Hanbridge, P. Levy, Geo. Davis, Chick Ames, Jas. Foster, "Pop" Hughes, P. Murman, W. Kohlway, C. Eppestein, Harry Little and Frank Thurber.

A co-operative dinner was given at the Techau Tavern Friday evening, May 24, 1912, by A. W. Bullard, manager of the Great Western Power Company. The table was prepared for 40 guests and not a chair was vacant. The party was made up of Mr. Bullard and the commercial department heads of the Great Western Power Company; Mr. Holberton and the commercial department heads of the Pacific Gas & Electric Company, and the San Francisco members of the California State Association of Electrical Contractors. Mr. Bullard in welcoming the guests told them that it was his aim to bring out a discussion which would bring before the gathering the trouble that it would be necessary to take up and adjust before perfect co-operation could be accomplished. He then called on Secretary Hanbridge who gave a brief history of the California State Association of Electrical Contractors and its work and ambitions to secure co-operation between contractors and central stations.

Mr. Holberton then being called on, gave the contractors a very clear view of why the central station does things and how they helped the contractors. Mr. Bullard then wanted a specified kick registered and Mr. Hanbridge delegated Mr. Aimes of the National Electric Company to demonstrate how it was to the contractors' advantage to get services inside of buildings free and to Mr. Louis Levy to show where it was wrong. Both sides put up strong arguments, and by Mr. Bullard's decision Mr. Levy won the argument. The correction of this evil was passed up to a committee from each power company and from the contractors who will hold regular meetings in the future.

An advertising talk was given by Mr. Bullard and Mr. Myrtle which all present listened to carefully.

TRADE NOTES.

The Oregon Electric Railway Company, Portland, Oregon, has ordered one quadruple equipment of No. 321 motors and HL control from the Westinghouse Electric & Manufacturing Company.

The General Electric Company has sold to the Power Specialty Company two turbine generating units for use in the new garbage incinerators at San Francisco. The rating is as follows: Two C. C. 4, 75 kw., 250 v., 3300 r.p.m., condensing, Curtis steam turbines.

The Tacoma Electrical Machinery Company, 117 South Twenty-fourth street, has been recently organized as a subsidiary company to the Holmes Machinery & Saw Works. The new company has bought the plant and outfit of the H. B. Taylor Company, and is prepared to do all lines of electric work, including repairing and renting of motors, electric light wiring, etc.

The Yuba Construction Company is building, in its shops at Marysville, Cal., two impulse wheels for the Alaska Gastinan Mining Company, which are to be direct-connected to General Electric generators. The wheels, which involve several novel features as to regulating the water, were designed under the supervision of George J. Henry. Lombard governors will be used in the installation.

Pierson, Roeding & Co., have secured a contract from W. L. Holman, who is building the cars for the Geary street municipal electric road, for 45 pairs of trucks, which are to be manufactured by the J. G. Brill Company of Philadelphia. The trucks are described as Brill No. 27, GE. 1. The Westinghouse Electric & Manufacturing Company's motors will be installed on all of the 43 semi-steel cars. The contract calls for 43 quadruple car equipments. Each motor is rated at 50 h.p. at 500 volts. Westinghouse H.L controllers will be used.

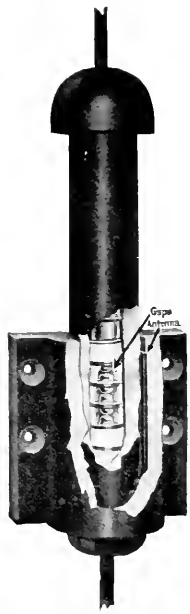
Contracts have been let for the pumping plant of the Snake River Improvement District Company, west of Weiser, Idaho, for aggregate of 400 h.p. Pumping plant will consist of two 150 h.p. motors, direct connected to 12 in. centrifugal pumps, and one 75 h.p. motor, direct connected to a 8 in. centrifugal pump, besides a number of secondary lift pumps. The main pumps will pump against a head of 98 ft. and will be used to irrigate fertile lands of the Ox Flat District. Fairbanks-Morse motors and Byron Jackson Iron Works pumps will be used throughout this equipment.

INDUSTRIAL

NEW LOW PRICED LIGHTNING ARRESTER FOR DISTRIBUTING SYSTEMS.

To meet the demand for a lightning arrester that will give adequate protection to distributing transformers, at a price that will permit its use for even the smallest transformers, the General Electric Company has recently placed on the market a new multigap arrester known as the compression chamber type.

In this new arrester the two conflicting requirements of a successful arrester, namely, ability to discharge at a low potential and prompt cutting off of the generator current have been met with remarkable success. In this arrester as in the older type of multigap arrester, the basis of operation is the rectifying action of the gases in the gaps which extinguishes the dynamic arc. Two special features, the use of antennae and the compression of the gases in the gaps, increase the efficiency of the arrester.



Compression Chamber Type of Multi-Gap Arrester.

The antennae are connected to the ground lead, and extend near, and parallel to, the path across the gaps. By their condenser effect these antennae reduce the potential at which the arrester will discharge, and thus permit the use of a large number of gaps. The large number of gaps and the compression of the gases in an air-tight chamber give prompt extinguishment of the dynamic arc. A series resistance of low value reduces the generator current to a point where it can be safely handled by the arrester.

The insulating case is of porcelain, with all joints filled with waterproof insulating compound. This feature does away with the necessity of enclosing the arrester in a box and aids considerably in reducing the cost of an installation.

The compression chamber type multigap arrester is not intended to supersede the multigap arrester with graded shunt resistance, but simply to meet the demand for a reliable arrester where the more complete protection given by the latter is not necessary and the expense of installing is not justified. The new arrester has been tried out by service laboratory tests and by several months' service on the lines of a large operating company. In all these tests it has thoroughly demonstrated its reliability.

N. E. L. A. CONVENTION SOUVENIR.

An elegant leather-bound eighty-page booklet was the souvenir presented by the National Quality Lamp Division of the General Electric Company, Cleveland, Ohio, to each of the delegates travelling to the N. E. L. A. Convention at Seattle on the six special convention trains known respectively as the "Red," the "Blue," the "Orange," the "Green," the "Pink" and the "Purple." The title of the brochure is "A Little Journey"—reminiscent of certain of Elbert Hubbard's literary works—and its introduction was written by no less person than "Fra Elbertus" himself.

The main text, which follows directly after a brief analysis of present electric train-lighting methods, by Mr. C. W. Bender, consists of terse descriptions of notable points of electrical interest along the routes of the trains, this material being arranged in the form of a diary, with blank lines for memoranda to be filled in by the tourist. The book is profusely illustrated with views of power houses, dams, transmission lines, street lighting installations, etc., selected from a collection of about three hundred such views. These illustrations and data were furnished to the lamp people by the electrical journals, and by central stations, electrical manufacturers, and supply houses all over the country. A map of the United States, drawn with special notations for the purpose, is included. All the illustrations are printed over tints. The souvenir as a whole might aptly be termed a "chose de luxe." The edition was limited to 1000 copies. The fact that so many different interests had an active part in contributing the data for the book is a practical exemplification of the slogan of its donors—"Co-operation, Progress, Quality."

The introduction by Mr. Hubbard reads as follows:

In the year 1876, when I attended scientific lectures at Harvard, a certain professor of physics once explained to us the nature of light.

I had a note book and industriously wrote down the principal points of the address, hoping thereby to memorize what the professor said, in order, if possible, that some day I might be just as wise as he.

Said the learned professor: "There is no light without combustion. There is no combustion without oxygen. When all the oxygen is consumed all light will go out, and that will be Judgment Day. Every form of life then will disappear from the face of the world, and the earth will be like the moon, an extinct planet."

The oxygen has not been consumed up to this writing.

It was not very long ago, that a man at Menlo Park, New Jersey, succeeded in sending a current of electricity through a vacuum. In this vacuum was a small filament, and the current, when turned on, produced a soft, mellow light that illuminated the room.

Light has been produced without oxygen.

Of course, if the inventor had enjoyed the same educational advantages that I had had, he would not have tried his fool experiment, because he would have known beforehand that there can be no light without oxygen.

Once, at the University of Chicago, I was introduced to a great man. This man has written books that nobody understands. And when I came into his presence I was a little

embarrassed, as I always am when meeting great people.

On this particular occasion there suddenly came to my mind a little advice once given to me by my old college chum, J. Robert Crouse. Said Crouse to me one fine day, "Whenever you are in the presence of highly educated people, genuine high-brows, and you feel a little embarrassed and do not know what to talk about, you should talk about electricity. You will never shock anybody. Here is what you will say: "Speaking of Electricity, it is the great mystery; nobody knows what it is; all we see is its manifestation." You can safely say this at any time.

"If you are out to a dinner party and there comes a little lull in the conversation, put this over: 'Speaking of Electricity,' (here cough gently), 'It is the great mystery; nobody knows what it is; all we see is its manifestation.'

"Of course, if you do not know anything about electricity, it would be well here to start something else. But usually the remark goes all right and people put you down as a Weisenheimer."

And so in the presence of the great man in Chicago I was going to say, "Electricity, the great mystery, nobody knows what it is; all we see is its manifestation" I was going to say it, when, would you believe it, he said it.

"Good-bye," I said; I knew he had fixed his gun, and this was all he had to offer, and so I made my sneakerino.

I ran down the steps and caught a trolley car, jumping on the front end. As I stood there by the motorman, a little behind him, I saw a sign over his head, "Do not talk to the Motorman." This suggested an interview, and so I said, "Partner, what is Electricity?"

"It's the juice," he said without an instant's hesitation.

"Yes, I know something about electricity, he added. "It's God's best gift to man."

"I thought woman was God's best gift to man," I ventured.

"Same thing," he answered, "Electric manifestation, the great mystery; nobody knows what it is; very dangerous if you do not know how to handle it!"

"I get off there at the next corner," I said.

The car stopped within a foot of the crossing, and as I stepped off on terra cotta, I said, "Good-bye, my friend."

"Good-bye, old man," he said. But he never even looked up at me. He didn't know that I was one of the great literary lights of the world—neither did he care a snap. He was just intent on carrying that car through in perfect safety. He saw everything and nothing; and as the car moved away I said to myself "There goes an educated man. He is on his job."

We say that electricity is everywhere in the atmosphere, but this is an assumption that passes for knowledge since no one can refute you.

Electricity has never been placed under the microscope; it has not been weighed in the scales; chemical tests fail to find it.

A wire that is charged with electricity looks exactly like a wire that is not charged.

Franklin caught it on a kite, but did not succeed in his endeavor to bottle it. All he caught was a cold.

We say that electricity travels. But this, too, is only a figure of speech, and a variation of the good old bromide that "All we see is its manifestation"

Yet we manipulate this particular medium of energy which we call electricity. We know some of the things we can do with it and we know a few of the things we cannot do with it.

Egypt, Assyria, Greece, Rome—great civilizations all—went down to dusty death, knowing nothing of electricity.

The whole science of electricity has been born, practically, within our own time and no man can say what the final achievement of the electrician will be.

Electricity is a phenomenon, just as man is a phenomenon.

Electricity is a form of attraction and repulsion; of give and take; of absorption and dissipation.

We believe that the life of man is an electric manifestation. We know that the man, as Walt Whitman said, "isn't the proposition that is contained between your boots and your hat, because this one hundred and seventy pounds of fluid gas and solid which we call a man can be emptied by a single dagger thrust of its power in an instant, and the thing left is not a man."

What is it that takes flight? We do not know. Is man a transformer? I think yes.

Electricity is the boundary line between the material and the spiritual. It is the most spiritual thing with which commerce has to deal, because it is an unseen thing. Yet it can be sold, measured, and delivered, but you cannot sell it on the basis of "goods returnable if not satisfactory." There are court records which show that it has been stolen.

The electrician deals with one of the most subtle secrets of God. His knowledge and his ignorance should keep him reverent.

The business of the electrician is to produce light, heat and power at will, rendering these things serviceable and safe for the use of man at the minimum of cost.

The electrician handles Truth in its most subtle form; because electricity occupies the twilight zone between soul and mattter. He concentrates the unseen intelligence and hands it over to the housekeeper for a consideration.

Electricity binds the earth together, for by its use we can put a girdle around the world in less than eight minutes, and because Shakespeare had Puck say he could do this in forty minutes, critics have said that Shakespeare guessed what Kelvin proved. Electricity is the very medium of co-operation in the broad modern sense. It has exterminated a thousand miserable and costly strifes and jealousies.

Electricity is the universal symbol of co-operation in Nature, so electricians should in their lives symbolize the Brotherhood of Man.

We disciples of Jove are public servants. We are not looking for an easy time. We know that the reward of good work is harder work and more of it.

Just now, you are having a brief play-spell; but it is only that you may recharge your batteries, and go back and turn the current on to a harder job.

Electricians are setting the world a pace in several respects. That hustling fraternity known as the "Sons of Jove," is one of the leaders in the race.

It's "All Together, All The Time, For Everything Electrical."

And it looks to me that everything is electrical. Certainly everything that has life, and everything has, even death.

I am glad to be on the wire with an organization that lays its course by the stars and is working in line with the forces of Nature, with the winds, the sunshine, the rain, and the all-enfolding night.

If we were to define the business of Deity we would say that He is an Electrician.

Yes, God is the Great Electrician.

He is the only one who understands the business.

He, alone, has a knowledge of this unknown thing of which we so glibly prate. It is His pet, His plaything, His joy, His pride!

This Little Journey into Universal Ignorance, upon which I hold no copyright, and as to which I have never been accused of violating the Sherman Act, is written just for the divertisement and amusement of my dear friends, the boys and girls who are attending the Convention at Seattle.

I want them to regard it as a compliment on my part to that enterprising organization whose slogan and ideal are "Co-operation, Progress, Quality,"—a slight token of my esteem for this organization and for those who are at its head.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—H. F. Woodill, founder of the Woodill & Hulse Electric Company, has purchased the interest of H. T. Duff in the business and will re-incorporate and enlarge its scope.

SANTA ANA, CAL.—Articles of incorporation have been filed by the Chapman Avenue Water Company of Orange. It will furnish, buy and sell domestic and irrigation water. Capital $20,000.

SACRAMENTO, CAL.—The Big Four Electric Railway Company, a $500,000 Tulare county corporation, has filed articles of incorporation to build from Tulare to Woodville, thence to Popular, thence to Porterville, and a branch line will run from Tulare to Visalia, making the main line and the branch thirty-four miles long.

ILLUMINATION.

PORTERVILE, CAL.—The Mt. Whitney Light and Electric Company has submitted an application for a franchise within the incorporated limits of the city.

LINDSAY, CAL.—C. B. Morganthaler has been granted a franchise for a period of 50 years to operate an electric system upon or under the streets and alleys of the city.

RICHMOND, CAL.—The Pacific Gas & Electric Company has completed arrangements for the installation of a complete distributing system for the Santa Fe section of the city.

SANTA BARBARA, CAL.—The Lompoc Gas & Electric Company of Santa Barbara County has asked permission to issue $75,000 in bonds, $50,000 on its plant and $25,000 on extensions.

EPHRATA, WASH.—The City Council has granted Martin Kramer and T. G. Anderson of Seattle a franchise for installing a 300 h.p. lighting plant to furnish light and power to Ephrata Valley.

SAN LUIS OBISPO, CAL.—Sealed bids will be received up to July 2, 1912, for the sale of a franchise applied for in the county of San Luis Obispo, for a period of 50 years to operate an electric system upon certain public highways in this county.

LOS ANGELES, CAL.—F. Yoker, manager of the American Graetzin Light Company, has asked for permission to make a demonstration of the Graetzin gas lights for the purpose of showing their alleged superiority over electricity for the purpose of street lighting. The subject was referred to City Electrician Manahan.

MONTESANO, WASH.—In the interest of a company promoting a new system of manufacturing illuminating gas, S. S. Silvis, of Aberdeen appeared before the City Council and requested that a franchise be issued to his company to operate a gas plant in this city. Matter referred by the council to the light commission for investigation and a report will be made at a later meeting.

OAKLAND, CAL.—Fred C. Turner, Commissioner of Public Health and Safety, has filed with the City Council a lengthy report of his investigations into the charges preferred by the Central Oakland Light & Power Company, which alleged that its bids for supplying the city with electric lights in District No. 5 were unfairly treated. Commissioner Turner explains that the bids submitted by the Central Oakland Light & Power Company, although lower in some particulars than those of the Pacific company, the saving of money to the city by accepting the former concern's bid would be so small as to be of no consideration when compared with the disadvantage resultant from awarding the contract to this concern. In conclusion, Turner reiterates his recommendation that the Pacific company be given the contracts for the service in all of the districts of the city.

SAN FRANCISCO, CAL.—The Railroad Commission has set June 12 as the time for the hearing of the complaint of the Mt. Whitney Power & Electric Company vs. the Tulare County Power Company, and the San Joaquin Light & Power Corporation. The session will be held in Porterville at 10 a. m. The hearing was granted on the application of the Mt. Whitney company which filed with the Commission a complaint against the Tulare and also the San Joaquin companies, under the provisions of the new public utilities act which provides that a corporation before doing business in a new territory must obtain from the Commission a "certificate of convenience and necessity," asking that such certificate be denied. Both companies made formal reply that the public convenience and necessity called for their entrance into the territory. The Mt. Whitney company has also asked to be allowed to modify its standard meter so one may measure for several motors.

SAN FRANCISCO, CAL.—Some confusion has been caused by the announcement that $3,000,000 new common stock of the Pacific Gas & Electric Co., sold to stockholders pro rata at $60 a share, will not be entitled to participate in the July dividend. The new stock will be issued as of June 17, while the books close for the dividend of $1.25 a share on the common stock of June 15. The new stock is to be paid for in five installments, the first being due May 20. In the circular announcing the issue of the new stock it was stated that stock could be paid for in full on any installment date, when certificates would be issued for full amount of stock paid for. Several houses in New York purchased large amounts of the warrants for the new stock and forwarded them to the office of the company here, with drafts for full amount of new stock. These houses held that stock should be issued to them of date of May 20, as they had made full payment on first installment date, instead of paying in five installments. It is held by the company, however, that all new stock will be issued as of June 17, two days after the books close, so purchasers of the warrants will not get a dividend on their stock until October. The fact that the new stock will not share in the July dividend has caused some decline in Pacific common.

TRANSPORTATION.

SAN BERNARDINO, CAL.—Entrance of the Pacific Electric Railroad into San Bernardino from Los Angeles over the public streets has been granted over the protest of property owners.

SACRAMENTO, CAL.—The Sacramento Valley Electric Railroad, incorporated to operate between Red Bluff and Dixon, has filed a petition with the Railroad Commission for permission to issue 300,000 shares of preferred stock at $100 a share and 20,000 shares of common at $100. The money from the latter is to be used, according to the petition for purchasing rights of way. The company declares it intends to pay 20 per cent commission to its stock sales agents.

TULARE, CAL.—In a statement issued by the Big Four Electric Railway details are given as to the financing of the project, the directors, length of road, etc. There will be 19 directors, five from Tulare, five from Visalia, five from Porterville, two from Woodville and two for Poplar. The road will be 41 miles long. The road will be financed by the Avery Investment Company of San Francisco, which will raise the money over and above what is locally subscribed.

The road, it is declared, will earn, approximately $13,000 per mile per year, and the construction will be $15,000 per mile.

MARTINEZ, CAL.—Thirteen suits to condemn rights of way for an electric line between Bay Point and Pittsburg, Contra Costa County, have been filed here by the Oakland & Antioch Railway. The present terminus of the electric line is at Bay Point and as soon as the rights of way have been obtained the line will be extended to Pittsburg, from which point it will cross the Sacramento via Chipps Island. The defendants in the actions instituted here are Thomas Thormey, James H. Wilson, F. E. Valch, Fannie Cunningham, Henry Ohara, Charles N. Wight, Chas. H. Wight, B. R. Banning, John Ohara, David Bartnett, the Morton Company, Bay Shore Land Company and the Bay Point Realty Company.

WASHINGTON, D. C.—William M. Abbott, general attorney for the United Railroads of San Francisco, appeared before the U. S. Supreme Court in the matter of the United Railroads of San Francisco against the city and county of San Francisco. The question before the U. S. Supreme Court is on an application for a writ of certiorari to review the judgment of the Circuit Court of Appeals for the Ninth District. The point involved is the right of the city of San Francisco to operate cars over lower Market street and for ten blocks on Point Lobos avenue. The case was submitted to the full bench, but, inasmuch as the court adjourns on June 10 until the first Monday in October, a decision at the present session is improbable.

TRANSMISSION.

ASTORIA, ORE.—Surveyors are in the filed now laying out a line from here to Seaside for the proposed electric line to be built by Mr. Robinson.

ALBANY, ORE.—Track laying on the Salem-Albany extension of the Oregon Electric Railway has been completed to Albany and regular electric traction service will soon be established to Portland.

CORVALLIS, ORE.—Construction work on the street car railway in this city by the Portland, Eugene & Eastern has started and is being pushed as fast as possible. The road is a standard gauge line.

CITY OF MEXICO, MEX.—Steps will be taken toward the erection of a big plant which will generate 65,000 horsepower. The Mexican Hydroelectric Company, capitalized at $30,000, will handle the concession.

LOS ANGELES, CAL.—The Southern California Edison Company has been granted permission to issue new bonds to the amount of $4,117,000. It was stated in the application that these bonds were to be exchanged for others previously issued and outstanding.

PORTLAND, ORE.—A force of electricians have started work on the electrification of the Southern Pacific's West Side lines between Portland and McMinnville, being employed in overhead construction, bonding and other work necessary to the electrification of the road.

EUGENE, ORE.—Plans for the development of 12,000 to 14,000 horsepower at Martin's Rapids on the McKenzie River, 33 miles east of Eugene, are being made by the Oregon Power Company, and surveying parties in charge of C. B. Nichols, chief engineer, now being at the rapids.

ALTA, CAL.—The Pacific Gas & Electric Company has started work clearing a right of way for the power line which is to be run from the Alta power house to Lake Spaulding. This line is to furnish power for the machinery to be used in the construction of the new dam, work on which has already commenced.

MONTGOMERY, CREEK, CAL.—The Mount Shasta Power Company is pushing work on its power development in the Big Bend of Pit River. Men are working at both ends of the tunnel that is to be six miles in length when completed. W. A. Cooper, manager of the company, who is on the ground, says the working force will be increased right away so that the tunnel will be driven at the rate of 400 feet a month. The length of the completed portion of the tunnel is half a mile.

SAN BERNARDINO, CAL.—The plant of the Southern Sierras Power Company is now completed and in operation, furnishing light and power in this city. Until the completion of the plant, the company has been using the old Lytle power plant, bought from that company some months ago. Work on the long power line from this valley to Bishop, in Inyo county, is steadily progressing. The steel towers are now structed from this city to a point far out on the desert, and the actual stringing of the copper is now under way.

DORRIS, CAL.—Within the next two months the giant power line being constructed from Dorris to Klamath Falls by the California & Oregon Power Company will be completed to Klamath Falls. The cement foundations for the power poles are built from Dorris towards Klamath Falls as far as Worden near the Lower Klamath Straits. These cement foundations are being placed every 500 feet. The power poles are set in pairs and a cross will then be attached to them very securely and the whole will be guyed with the power lines themselves. The line is following the Southern Pacific right of way to the Raemes ranch four miles south of Klamath Falls, where it will cross the Klamath Falls and follow the west shore of the river and Lake Ewauna to the present power station on Link River in the city of Klamath Falls.

TACOMA, WASH.—On the ground that the vested rights of the Sumner Lumber Company, a $40,000 concern on the White River, have been jeopardized by the construction of the Pacific Coast Power Company, a $12,000,000 power plant at Lake Tappe, and Dieringer, Judge Card of the Superior Court signed a judgment giving the lumber company damages in the sum of $1000 and enjoining the power company from diverting the water of the White River to Lake Tapps. The power company immediately filed notice of appeal to the Supreme Court. Judge Card's decision means in effect that the big power plant cannot be operated if such operation requires all of the water of White River. Judge Card holds the river is navigable for floating logs and single bolts and the plaintiff as a boom company acquired vested rights on the stream before the Stone & Webster interests began to use the water.

TELEPHONE AND TELEGRAPH.

MILES, WASH.—The Local & Long Distance Telephone Company, headquarters at Davenport, is building a line north of Davenport to old Fort Spokane and will connect with Miles about July 1.

PHOENIX, ARIZ.—The Pacific States Electric Company of San Francisco has applied for a receiver for the Overland Telephone & Telegraph Company, which operates an extensive system in Phoenix and Northern Arizona. The assets of the Overland are given at $430,000, with liabilities of $700,000.

PHOENIX, ARIZ.—The Bell Telephone Company has offered the Arizona Telephone & Telegraph Company $2,000,000 for its system, which connects Phoenix, Prescott, Tucson, Bisbee, Tombstone, Globe and Yuma. The property also includes a toll line extending through the Imperial Valley to Los Angeles. The stockholders of the Arizona company will meet in Tucson June 15 to accept or reject the offer.

OLYMPIA, WASH.—The public service commission has entered a formal order authorizing the stipulation between the Puget Sound Independent Telephone Company and the Independent Telephone Company, the Sunset Telegraph & Telephone Company and the Northwestern Long Distance

Telephone Company, by which the Bell concerns agree to give the patrons of the Puget Sound country long distance service over its lines.

SANTA ANA, CAL.—The City Trustees and officials of the Pacific Telephone & Telegraph Company have come to an adjustment of their differences and as a result the city will offer a telephone franchise for sale, the Pacific company to bid upon it. The company paid $2000 into the city treasury as a compromise sum for back taxes; that is, money that would have come to the city had the company been operating under a franchise. Two per cent of the gross receipts from January 1, 1912, is to be paid later.

BAKER, ORE.—Richland has solved the problem of communication with the outside world by installing a wireless system. The town is in Pine Valley, 60 miles from here, and has been unable to get a company to put poles into that district and therefore has been unable to keep in touch with the world except by mail which runs every other day from here and takes a day for delivery. Taking the matter in their own hands, the citizens organized a company and have secured the wireless apparatus which they are now installing.

PASADENA, CAL.—The City of Pasadena has filed with the State Railroad Commission a petition of intervention in the case now pending before the Commission concerning the proposed merger of the Pacific Telephone Company and the Home Telephone Company of that city. The city asks that in case assent is given to the consolidation such conditions be imposed as will definitely assure the people of Pasadena an adequate service within the limits of the municipality, and also proper long-distance telephone facilities. It further asks that any consent the Commission may give be conditioned upon the ratification of the people of Pasadena.

ALHAMBRA, CAL.—The Pacific Telephone & Telegraph Company last week sent the City Council a draft for $926.10, in payment for the use of the city streets for a period of over three years. The payment was made under the working agreement with a former council, in lieu of a franchise. For some time the Pacific has been trying to get a franchise to continue operations in this city. The move has been opposed by a large number of citizens who have signed petitions requesting the council to refuse the franchise and to compel the company to consolidate with the Home Telephone Company which has a grant to operate in Alhambra. The draft presented the council is 2 per cent of the gross receipts of the company covering the period from December 15, 1908, to March 31, 1912.

LONG BEACH, CAL.—The local telephone companies will be required as a result of the passage of an ordinance by the City Council, to furnish detailed statements under oath showing the number of telephones owned by the companies and in operation, the rate charged by each telephone company, the total receipts for local telephone service for each month, the monthly long-distance charges for the last 12 months preceding June 1 of this year and all revenues derived from all sources. The ordinance also requires the telephone companies to give a statement in detail showing the number of poles, quality and amount of wire on hand and in use, number and extent of conduits under ground, description of real estate, buildings, furniture, equipment and other personal property, and the aggregate value of plants and properties. There is further required an itemized statement from each company of all expenditures made for supplying telephone service to the city of Long Beach and its inhabitants for the period of 12 months next preceding June 1.

WATERWORKS.

VENICE, CAL.—The People's Water Company has sold its plant to the Funding Company of California, a Los Angeles corporation.

PASADENA, CAL.—The date of the water bonds election has been set for June 27, and the amount of bonds to be voted on as $1,250,000.

SAN DIEGO, CAL.—The City Council has passed a resolution favoring 320 bonds of $1000 each, and 40 at $500 each for water extension and repair fund.

SPOKANE, WASH.—Contracts for the water main extensions in the Manito Heights Addition were awarded by Elmendorf & Elmendorf to A. Wold, the bid being $9750.

COEUR d'ALENE, IDAHO.—The ordinance providing for the purchase of the water plant from the consumers' company for $180,000 passed the council at its second reading.

SANTA MARIA, CAL.—The Domestic Water Company of Santa Maria will sell all water by meter rates from July 1. For fire protection a new high pressure pump is to be installed.

REDLANDS, CAL.—In a hard fought election the municipal water bonds were voted 5 to 1. The election authorized the bonding of the city to the amount of $600,000 for the acquisition of a municipal water system.

LOS ANGELES, CAL.—The Public Service Commission has authorized the commencement of construction on the aqueduct distributing system. If the plans mapped out by the Commission are carried through, the aqueduct will deliver Owens River water to the city simultaneously with the completion of the rest of the system. Briefly, the Commission authorized Chief Engineer Mulholland to do the following: "Proceed forthwith to begin work on the Franklin Canyon to Engineer Mulholland's statement. Figure on bringing the water from the Fernando reservoir to Franklin Canyon, and thence through the Cahuenga district to Inglewood and Redondo, through a six-foot steel pipe-line, a distance of 20 odd miles, the cost of which will exceed $1,000,000. Submit figures as to the cost of extending the arms from the main trunk to Los Angeles, Pasadena and other districts. Secure easements for the right of way for the pipe line, as above stated. (There is only 6500 feet of right of way required, as the balance of the district is covered by highways and dedicated streets, under which the State law enables the Commission to run its pipe line.) The easements are also to permit the city to run its electric power distribution system."

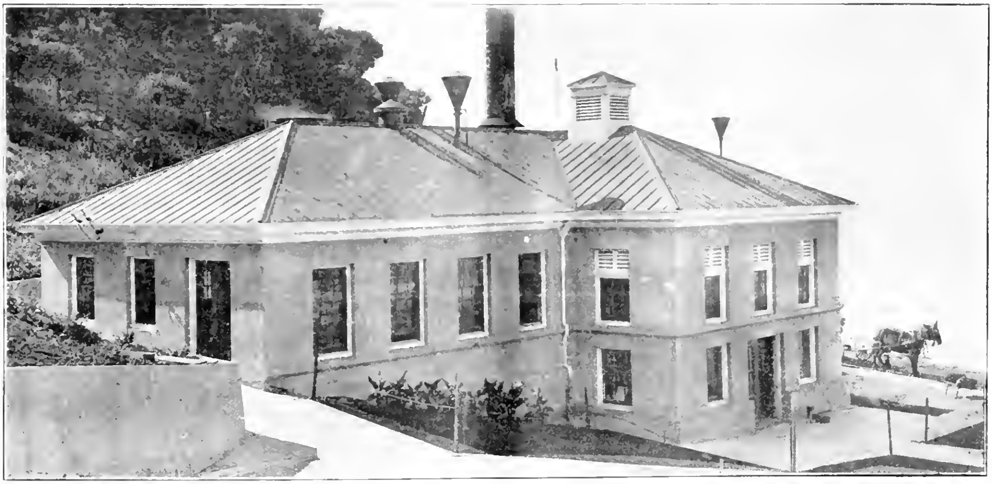
OAKLAND, CAL.—The second step in the formation of a municipal water district on the east side of the bay, looking to the acquisition of the plants and water-bearing properties of the Peoples Water Company and the Bay Cities Water Company by the allied municipalities, was taken, when B. H. Pendleton, chairman of the Oakland Water Commission, filed with Mayor Frank K. Mott a comprehensive report of the investigations of the commission. The cities interested in the water district are Oakland, Alameda, Berkeley, Alvarado, San Leandro, Piedmont, Albany and Emeryville. Mayor Mott will at once call a third conference of the mayors proposed water district. The result of the commission's instruction will cost in the neighborhood of $70,000, according of the eight municipalities which are to be included in the tunnel. This will be nearly 4000 feet in length, and its convestigations will be set forth in a report, and the third step will be taken, that of authorizing the circulation of petitions to the Alameda County Board of Supervisors demanding the calling of a special election, at which the citizens are to vote on the formation of a water district. The Oakland Water Commission consists of B. H. Pendleton, chairman; George W. Dornin and W. T. Veitch, and their investigations have extended nearly two years. The report gives in detail every item of information regarding valuations, production, cost of installation, equipment, etc., which can be of any use in working out the scheme for the formation of the municipal water district and the acquisition, by purchase or condemnation proceedings, of the properties of the two water companies.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII | SAN FRANCISCO, JUNE 15, 1912 | NUMBER 24

ANGEL ISLAND POWER PLANT

Some years ago the Federal Government assumed control of all islands in San Francisco Bay. Several of these have now become important stations for government work. For instance, upon Goat Island is to be found the United States training school with its beautiful equipment, the island of Alcatraz cuts the horizon with its prison walls, while Angel Island is maintained as a detention port and also for quarantine purposes. So extensive have become these various activities of the government it has been found necessary to install on every island a power plant for the supply of heat and light.



Power Plant at Angel Island

The Pacific Gas & Electric Company is now engaged in constructing a cable connection with Angel Island in order to supply to the government electrical energy for the quarantine station. However, as steam heat is necessary for the detention station, it is doubtful if the power plant will be done away with.

At the detention station on Angel Island is a thoroughly modern power plant installation. The building is composed of reinforced concrete and is shapely in appearance both in structure and surroundings. Within the building is to be found two 75 h.p. Stirling boilers equipped with the Witt fuel system of furnaces and burners, a single burner being supplied for each boiler. The steam generated by these boilers is used to heat the main buildings which are four in number, and in addition, to drive two reciprocating units in the adjacent room, which generate the electrical supply for the detention station.

The reciprocating units are situated in a concrete room 30 x 40 ft. In this room is to be found a 35 kw., 125 volt, 280 ampere, 300 r.p.m., direct current Westinghouse generator directly connected to a McEwen tandem compound engine, which operates with a 10-inch stroke. The two cylinders of this engine are 6½ and 13 in. bore, respectively. There is also held in reserve for emergency conditions a 50 kw., 125 volt, 400 ampere, 300 r.p.m. direct current Westinghouse generator directly connected to a 100 h.p.

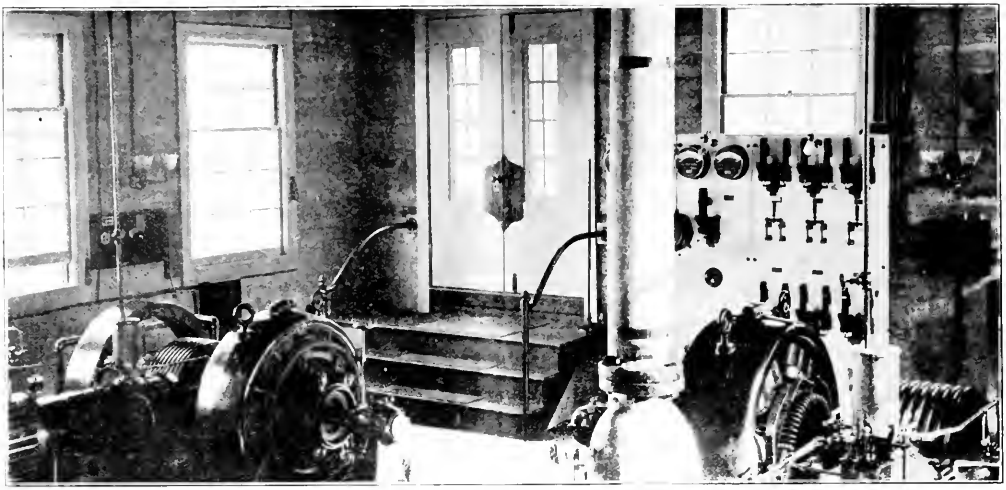
McEwen tandem compound engine, which operates with a 12 in. stroke and has cylinders of 7 and 14 in. bore, respectively.

The oiling system for these reciprocating units is homemade but effective. It consists of a steel tank, 2 ft. in diameter and 3½ ft. high, situated 15 ft. above the engine plane. It operates by a gravity system and is returned to the tank by means of a hand pump.

The ammeters and voltmeters upon the switchboard are manufactured by the International Electric Meter Company of Chicago, the recording voltmeter is of the General Electric type, while the remaining complete switchboard equipment is furnished by the Westinghouse Electric & Manufacturing Company.

The condensers, which maintain a vacuum of from 27 to 28 inches, are placed on a lower deck in the main engine room. This lower deck is of concrete construction on all sides. Immediately above these condensers are to be found the vacuum gauges under which each condenser operates, and also a pressure gauge which indicates the pressure of the steam being supplied to the boilers by the reciprocating units.

The hot well for the waters from the condenser is a square steel tank, 5 x 2½ x 4½ ft., in the rear of the boiler installation. A Blake 10 x 8½ x 10 inch duplex pump is used to force the circulating water from the bay through the condensers. This pump is also held in reserve for flushing the sewers and in case of fire in the main buildings. A 6 x 4 x 6 in. Blake pump and a 4½ x 3 x 4 in. Fairbanks, Morse pump are utilized in supplying the feed water to the boilers. Two 3½ x 2¼ x 4 in. duplex Worthington pumps are used in forcing the oil to the burners. A National feed water heater is used in the water supply. The oil for the furnaces is passed through a Worthington oil meter in its course to the burners and as a rule but 1100 gallons of oil are consumed in the 24-hour run.



Interior of Ang Island Power Plant

THE ALL ELECTRIC INTERLOCKING SYSTEM[1]

BY P. J. OST.

The oldest form of interlocking is what is known as the mechanical type in which the power is manual, being transmitted by pipe, rods or wires. This system is satisfactory where the number of functions is not great and the traffic not heavy. However, with the increase of transportation demands the plants began to grow to such size and to require so many men to operate them that some form of power operation became imperative.

This demand was cared for by various systems, the majority of them employing compressed air for the transmission of power, until the year 1891, when John D. Taylor brought out his first electric device. It was only after years of work and study that the first installation was made on the Baltimore, Ohio & Southwestern at East Norwood, Ohio. This plant was built in the Baltimore & Ohio shops. That Mr. Taylor had planned well is indicated by the fact that to this day his ideas, incorporated in his first plant, are the basis of most electric interlocking designs.

In all interlocking work, as the name implies, the levers are so inter-connected as to prevent aligning two conflicting routes at the same time, also all switch and derail levers are so inter-locked with signal levers that it is impossible to give a proceed signal until the route is complete, neither may a route be changed with a signal in the proceed position.

A motor is used for each switch, derail and signal, except low signals, called dwarf signals, all of which until recently have operated by a solenoid.

In mechanical operation the force required to move a lever served in most cases as an indication that the movement had actually taken place. However, when power came into use the lever man could not, as it

[1]Paper presented before San Francisco Section A. I. E. E., May 24, 1912.

were, feel his plant, so some arrangement had to be made whereby he was advised of the proper operation of the various parts in response to a lever movement. This feature is known as indication and should only be given on the completion of a movement.

With the various types of pneumatic plants this indication was very easily given by the opening or closing of a battery circuit through contacts actuated by the mechanism, but with the advent of electricity for power a cross between two wires might give a false indication. In order to make the indication different from and independent of the power current a means of using the counter electro motive force generated by the motor for indication was devised, for the more important operations, namely, both normal and reverse movements of all rail point operating machines and for the movement of a signal from "proceed" to "stop." With solenoid dwarf signals the indication is secured by the use of power current over a separate wire.

In order that the leverman will respect the indication he is required to operate the levers in two movements. The first part of the stroke effects a preliminary locking of all routes in conflict with the new position of the lever, at the same time making the necessary electrical connections to secure the desired action. In this position the lever rests against the indication stop. When an indication from the function is received the stop is removed, allowing the completion of the lever stroke, permitting any subsequent lever movements to be made to set up a route. In this way the operator must receive an indication from all switches and derails in a route before being able to give the proceed signal. This delay is, however, very slight, in a majority of cases being less than two seconds.

The wiring is divided into three classes, controls, indications and commons, the names describing their functions. Switch machines have two control wires which serve also as indication wires. While one of the pair is control the other is indication, and vice versa. High signals have one control only, which acts as indicator wire also. Solenoid dwarfs have one control and one indication wire. Main common or the wire for power return reaches each function and in later installation is tapped to the indication bus, making it serve as indication common also; in older plants a separate common wire was used.

Control wires receive their power through the lever contacts and a fuse from the switch or signal bus mounted on a slate board at the rear of the interlocking machine. Main common goes to the negative terminal on the power operating panel.

In addition to the interlocking machine, and the switch and signal mechanisms, there are generally installed a 110 volt storage battery, the size depending on the plant, with a distributing switchboard, together with the necessary charging arrangements and charging switchboards. At isolated points it is customary to use a gasoline engine generator set for charging, while where electric power is available advantage is generally taken of it.

It will be of interest now to follow the operation of a switch or derail movement. The switch bus on the machine is connected to the positive side of the battery through one pole of a double pole circuit breaker mounted on the operating or distribution panel the signal bus being connected through the other pole. Each lever is provided with a separate fused tap off the bus bars. Under each switch lever are mounted two pairs of magnet coils. These magnets are mounted vertically one above the other, the poles facing, and are provided with a common armature. The lower coils are known as safety magnets while the upper ones are the indication magnets. Through the safety magnet must go all current received from the bus bar for the particular function to which it is attached. From the safety magnets the circuit leads to a pair of selector magnets where it divides, one connection going to front lever contacts for the reverse control and one to the rear lever contacts for the normal control wire. These lever contacts are placed in two groups, each group consisting of four fingers or brushes secured to a stationary block of insulating material. The movable part is another block of insulating material carrying two contact strips for bridging the fingers. This movable part is attached to the lever and travels with it. In the normal position of the lever, normal control wire is connected to the switch bus bar by the strip bridging the two fingers, also reverse control wire is connected to the indication bus through the other strip and the indication magnet. In the reverse position, normal control goes to the indication bus while reverse control gets battery. Following one of the control wires current is delivered to a pole changer switch controlling the armature connections of the motor, also the indication connections, back to the interlocking machine. The motor is of the series type and through the reversal of armature connections in the pole changer operates in one direction to set the switch points one way and in the opposite direction for the other position of the points. The pole changer is normally operated entirely mechanically by the last movement of the switch point locking device. It is, however, also under the control of two sets of magnets, so that should the points fail to complete their movement giving an indication, the position of the control lever may be shifted and, through the energizing of one of the sets of magnets, cause the pole changer to assume the position corresponding to that taken by the lever. It will be seen that this arrangement places the switch so under control of the leverman, that should the points be blocked with snow, sand or anything else, the operator may work the points back and forth to dislodge the obstruction, thereby permitting the desired movement of the switch to be completed.

The operation of the motor causes three separate and distinct movements occurring in the following order: Unlocks points raising detector bar at the same time, sets the points to the new position, and locks them there, at the same time lowering the bar, the last inch of travel of the locking plunger throwing the pole changer switch, disconnecting the live control wire and connecting the dead or indication wire to the still revolving motor whose armature connections are reversed. The current generated by the motor passes over the commons to the indication magnets of the lever, returning over the control wire to the other side of the motor. Kindly note here that the generated indication current flows in the same direction as bat-

tery current normally does, however, being generated at the opposite end of the conductors from that to which the battery is connected. It flows in a direction the reverse of what battery current would flow in an indication wire crossed with a control wire.

The opening of the control wire at the pole changer deenergizes the safety magnets located in the interlocking machine immediately below the indication magnets, allowing the indication current to pick up their common armature giving a complete indication. By this arrangement, in order to secure an indication of a switch having operated, the motor must revolve and several makes and breaks of circuits take place in a regular order. The most damage a failure of any of these actions can cause is a prevention of an indication requiring that the movement be made over again.

The function of the safety magnets is to prevent a false indication due to a connection between the two control wires allowing power current to flow back through the indication magnets. This is accomplished by making all current for either control wire pass in series through the magnets, in this way all current tending to cause an inducation must also act on the safety coils. As the common armature for the two sets of coils rests on the poles of the safety magnets and is a quarter of an inch from the poles of the indication coils an equal current in both sets of windings could cause no movement of the armature giving a false indication.

In the case of signals only one movement need be rigidly guarded by indication, as a signal might fail to show "proceed" without more damage than stopping a train; but one saying "proceed" when it should say "stop" might cause no end of trouble.

All standard signals are worked on a plan requiring power to make them move to and remain in the position indicating "proceed." In other words, they are so hung and counterweighted that if left to themselves they would always indicate "stop." In electric interlocking the motor is so connected to the signal that the counterweight action setting the signal to the horizontal position revolved the motor as a generator. The motor is not connected to the wires leading to the interlocking machine until almost the end of the movement, when current is allowed to pass through the indication magnets, insuring that the signal has assumed the desired position. At the same time the loading of the motor serves as a dash pot to bring the mechanism to rest without undue shock.

With solenoid dwarf signals a contact is closed between the indication wire and the return wire by the signal being returned to the "stop" position. This circuit is broken by the completion of the lever stroke cutting off all flow of current.

As shown before, all indication current flows in the same direction as operation current, but coming from an outside source it also flows in a direction opposite to that which operating power flowing out over a control wire and returning over an indication wire would take. This feature is taken advantage of to locate and make harmless any cross between wires. In order to accomplish this a polarized relay is wired into each indication circuit or placed in indication common. Normal indication current causes no movement of the armature, however, a cross will immediately cause current to flow in a reverse direction, opening the relay contacts, breaking the retaining circuit of the main circuit breaker. By pulling the fuse of the function in trouble, the cross may be temporarily removed until repairs can be made.

As was stated before a small current is necssary to hold a signal in the "proceed" position and unless provision is made for supplying this small current to the signal bus bar the opening of the circuit breaker might put the signal to 'stop" in the face of a train approaching on a route not affected by the cross. To prevent this the contacts of the circuit breaker are generally shunted by a resistance great enough to prevent passage of current sufficient for the clearing of another signal yet small enough to hold several signals in the "proceed" position.

As an additional check on the position of all facing point switches and derails it is customary to break either the control or return wire of a signal through a circuit controller attached directly to the rail points. At times advantage is taken of this feature to select by the position of a switch which arm of a two-armed signal shall be cleared. With one type of signals this is done by closing through the controller either one of two field windings on the signal motor, thereby securing a reversal of the direction of rotation.

The power required for operation is small, a switch motor requiring 6 amperes for only a little more than one second, and a signal but 2 amperes for about four seconds. A solenoid dwarf requires 5 amperes for only a fraction of a second. As an example, the aggregate of power required on a busy 52 lever plant passing some 500 trains per day will not amount to much more than 200 kw. hours per month. This including the lighting of some twenty signals for twelve hours each night with one candle power lamps. With a good gasoline engine plant from 2500 to 3000 lever movements may be secured for each gallon of fuel.

The apparatus described in the foregoing is that made by the General Railway Signal Company. The Union Switch & Signal Company has placed on the market three types of all electric plants. Their most recent type is similar in principle to the electro-pneumatic system, in that power is always maintained at each function, a pair of control wires serving to operate remote control switches for applying it to the motors.

There are in addition to the systems mentioned several other types on the market among which are those manufactured by the Hall Signal Company and the Federal Signal Company.

In small plants various methods are used in running the wires. Where the functions are stretched along one road for some distance, as in the case of sidings and crossovers at stations, it is not unusual to make use of a pole line. Where the movements are bunched, the wires are often carried in a wooden trough, or trunking as it is generally called. In this case frequently the wires are sealed in with asphaltum. At large and more important plants, some form of underground conduit is employed, manholes and handholes being used the same as in subway construction, in a city.

SOME FEATURES OF THE DESIGN AND CONSTRUCTION OF DYNAMO ELECTRIC MACHINES.[1]

BY CARL E. JOHNSON.

(concluded)

Alternating Current Machines—II.

Under the classification of alternating current machines we have the single phase of several different types and the polyphase motors of the constant, variable, and the multi-speed types.

For a majority of requirements there is no question but what the squirrel cage polyphase type, everything considered, is nearest to the ideal. This is by reason of its simplicity, lightness, low cost, high efficiency and general durability. In this motor we have two separate windings. One mounted on a stationary and the other on a rotating core and without commutator or the complicated parts of other types. The stationary or stator frame is always built up of steel laminations in the slots of which the windings are placed. The slots may be open or partially closed. In very few instances totally closed slots are used. Ordinarily small machines for the lower voltages are made with partially closed slots while the larger machines and machines for higher voltages have open slots for the reason that these allow the use of specially insulated coils. The closed slots, however, are preferable where it is possible to use them on account of the improved operating characteristics. The distinctive difference between the coils for a partially closed slot and open slot winding is that the latter are completely insulated and treated before being placed in the slots.

Basket or Diamond shaped coils are the most universally used. The assembly of the coils in the machine with the partially closed slots differs from the same operation in other types in that the coils are usually threaded through the openings into the slot one or two at a time. With this method the only insulation between the different turns of the same coil being the cotton covering on the individual wires. Basket type coils are mostly used with the one coil per slot winding. This means that each side completely fills one slot so that for instance in a 48 slot core only 24 complete coils will be required to make up a set. The ends of a coil iron to iron being taped after the coil has been put into the slot. The simple threaded diamond or two coil per slot type is wound either on a mould which finishes the coil to a proper shape or wound on pins or in a loop and pulled out similar to the direct current coils previously mentioned.

The span or throw of the coil here as in the armatures has a direct bearing on the performance of a given machine. A full pitch winding is one in which the span of the coil is equal to the number of slots in the core divided by the number of poles.

Fractional pitches are generally used on account of the considerable gain in end space and saving in copper. The effect of reduced span of the coil is the same as a reduction in the number of turns although the effect is not in direct proportion. From this it will be seen that this variation in span gives a very flexible means of obtaining different performances from a standard frame with a given number of turns per coil. For a given frame, number of slots, size of wire, turns per coil, and the connections of the groups remaining unchanged, a motor with a throw of 1 and 10 will have a greater available torque than one having a throw of 1 and 13. The increase in torque being obtained, however, at a sacrifice of power factor.

In alternating current motor stators, the groups are laid out according to winding diagram selected or necessary. The number of groups being equal to a product of the number of poles by the phase of the motor. The group may either be uniform, alternating, or irregular, according to the design of the motor. If the group is uniform all groups will consist of an equal number of coils. If the group is alternating every other group contains an equal number of slots and coils. If the grouping is irregular there is no apparent uniformity in the number of slots and coils per group but the total number of conductors per circuit per phase is usually the same. The groups are formed by connecting the required number of coils together, the end of the first coil to beginning of the second, etc., the beginning of the first coil and end of the last in the group forming the beginning and end of the group. Diagrams are made or drawn for the desired method of connecting the group. When it is desired to use one winding that may be connected for two or three standard voltages; the winding should be laid out if possible for equally satisfactory operation on either connection and that a minimum amount of labor will be required to change from one to the other. This laying out of connections for parallel circuits must be specially borne in mind, because it is evident any eccentricity of the rotor with respect to the stator will mean an unbalancing of the current in the different parallel circuits.

In connecting 3-phase stators in star the operation will be simplified if it will be remembered that in traveling from each of the three leads to the star points the direction of travel is reversed in adjacent groups.

Any star connection can be readily changed into a corresponding delta by opening the common junction and connecting the inner end of phase A to the outer end of phase B, and the inner end of phase B to the outer end of phase C, and the inner end of phase C to the outer end of phase A.

In laying out a given size frame for several different speeds and ratings it is sometimes necessary, in order to make the standard number of slots fit all these requirements, to use an irregular grouping.

Fig. 1 shows a standard 48 slot stator with a uniform grouping of 4 coils per pole per phase, which, as shown, is connected 2 circuit Y. In order to connect the same number of slots and coils 6 pole it is necessary to use an irregular grouping, which, as shown in Fig. 2, is also connected 2 circuit Y. The small figures under the arrows denote the number of coils in each group. By totaling these up it will be seen that the total number of coils per phase are the same. It is not possible to connect this winding as shown for 4 circuit or 110 volts but it can be readily changed to single circuit 440. The phase coils or coils separating the differ-

[1]Paper presented before Los Angeles Section, A. I. E. E., April 30, 1912.

ent groups are usually given an extra lapping of treated cloth over the outside ends. After connecting, the stator frame is usually given one of the many moisture and dirt repellant treatments,

The rotating part with its squirrel cage secondary winding as usually made is the simplest mechanically and at the same time is the most rugged and compact form of moving element to be found in any type of commercial electric motor. Its operating characteristics are dependent to a great extent upon its electrical resistance, a rotor with a low resistance will have good efficiency and small slip and will have less starting torque for a given current; on the other hand

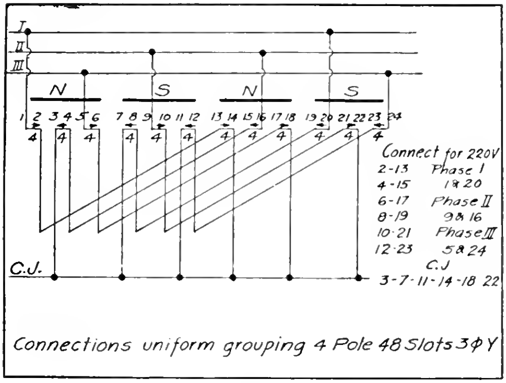


Fig. 1.

a rotor of high resistance will have low running efficiency and a large slip and will give a high starting torque with a minimum current. These characteristics make the high resistance rotor adaptable to some classes of machine, crane, and elevator work where starting under heavy load is frequent and operation required for short intervals only. The high resistance rotor exerts its maximum torque at starting and the torque decreases as the speed increases. With their load they accelerate slowly developing approximate double full load torque with about two and a half times normal current although full voltage is at once impressed on the stator. There is a marked contrast to this performance when it is considered that with the standard low resistance rotor, all other conditions being equal, to develop only full load torque at the start requires about four times normal current. In their favor also is the elimination of the expensive controller and resistance, brushes, brush-holders and collector rings, all necessary with the phase wound rotor. It has been found by experience that the best results are secured with a slip as high as 20 per cent and to date, to my knowledge, these motors have not been developed in sizes much above 15 h.p. owing to the starting current.

There are many styles and methods of construction of both different types employing bars of many shapes. The rotor bars are usually cut from soft drawn bar stock and inserted in the rotor slots which, with some exceptions, are as a rule always partially closed.

There is very little choice between bare and insulated rotor conductors in the smaller sizes.

On large rotors where voltage is appreciable from one end of the bar to the other, local currents are set up in the punchings where bare bars are used which will reduce the starting torque but will have very little effect under full load running conditions. In such case it is advisable to insulate the bars.

The end rings are made of copper, brass, or various grades of resistance alloys. The resistance of the rings and consequently the characteristics of the motor depend upon both the width and thickness of the ring as well as its composition and may be varied over a wide range by changing these dimensions.

Solder is sometimes used for fastening the rotor bars to the end rings but too much stress cannot be

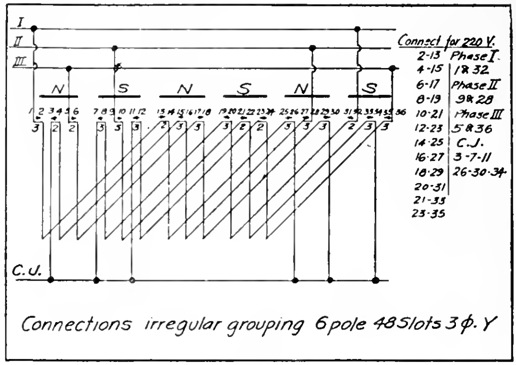


Fig. 2.

laid on having, first of all, as perfect a mechanical joint as possible. Under severe conditions of service, solder will, very often, melt, and unless there is a perfect mechanical joint to rely on, the result will be a serious loss of speed, necessitating repairs. If solder is depended upon at all it should always be hard and of high melting point.

Some forms of fans are usually provided to promote ventilation and aid in the dissipation of the heat. Rotors of the constant speed type are sometimes wound with short circuit diamond shaped coils and instead of being connected together each coil forms an independent closed circuit or loop. This arrangement allows of thorough ventilation and will develop a good starting torque.

The stators of the variable speed poly-phase motors are practically identical with those of the constant speed type. The rotors are phase-wound usually with diamond shaped or open end coils of either wire or strap inserted in partially closed slots. The coils of each group are connected in series and the groups of each phase are ordinarily connected in series, the phases being connected, usually in star.

These motors are generally used where it is necessary to start a heavy load with small starting current and operating for long intervals of time with good efficiency or wherever it is necessary to vary the speed from time to time. Their operating characteristics are similar to those of a shunt wound direct current motor, where speed variation is obtained by inserting resistance in the armature circuit. Three-phase wound rotors are generally used with either two or three-phase wound stators for the reason nothing is gained

in the use of two-phase rotors and they usually require an extra ring. In some few cases phase wound rotors have been equipped with only two rings, the other open end being grounded. This simplifies construction, somewhat lessens cost, but is unsatisfactory in as much as the bearings are called upon to carry a portion of the rotor current.

Some classes of service and conditions call for a polyphase motor which will give different speeds and maintain each speed irrespective of what portion of its full rated load it has to carry. To meet these conditions there has been suggested and developed a number of different schemes. Of these different types let us dwell upon, brieffy, the most extensively used or what is commercially known as the multi-speed motor.

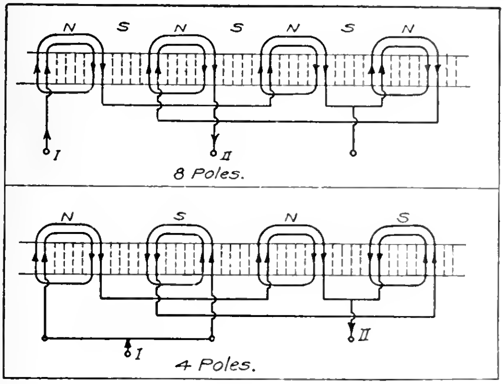


Fig. 3.

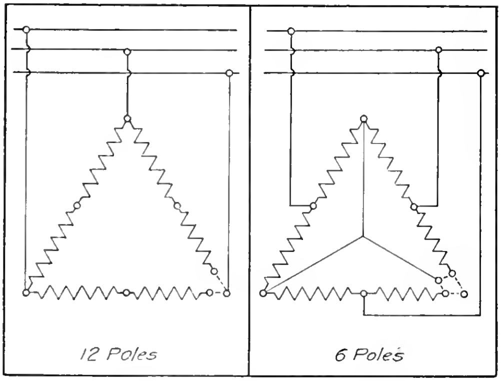


Fig 4.

The stator structure and rotor of this motor is similar also to the standard polyphase motors. In this type of motor the different synchronous speeds are obtained by changing the connections and re-grouping the coils of any one or two stator windings and thereby changing the number of poles. Fig. 3 shows a simplified diagram of one phase of a multispeed motor as connected for 4 and for 8 poles. The standard type of squirrel cage rotor is in most cases used, although in this type of motor it is also possible to use the phase wound rotor. By a combination of multi-speel stator and the phase wound rotor it is possible to obtain speed variation of a very wide range at good efficiency but the motor and control apparatus become so greatly complicated that the saving in power is not warranted. There are a number of different methods that may be used in connecting the windings of such motors, the selection of connections in any case depending upon the relative maximum outputs required at the different speeds. In the two speed motor with single winding the connections which will work the material to best advantage is the one in which the groups are connected in two circuit star for a 100 per cent maximum output and speed, and connected in single circuit delta for 50 per cent speed. The 50 per cent speed connection will carry approximately 65 per cent of maximum output.

Reference to Fig. 4 will show one method of connection by which it is possible to secure two speeds. By combining two such windings on one stator, one for four and eight poles and the other for six and twelve poles it is possible to procure four distinct speeds. A four speed motor of this kind would have fourteen leads to connect to. The connections for the different speeds being accomplished with the aid of a small drum.

In this type of motor approximately one-half of the total amount of copper is inactive and the delta circuit which is not in use must be opened at one corner to eliminate complications through induced currents.

In these motors the efficiency is approximately the same at each speed and the power factor, which is lower at full speed than the normal motor, is reduced very greatly at the lower speed. The percentage of slip remains approximately the same for each speed and the starting torque per ampere varies approximately inversely as the speed.

Under the heading of single phase we have the split phase, resistance reactance, and several types of the repulsion. The split phase induction motor is quite generally used, especially in small sizes, because its construction and winding is simple and inexpensive. It is inherently a constant speed motor and cannot be made to vary. The stator is provided with a main winding and a starting nearly always in partially closed slots. The main winding consists of many turns of relatively heavy wire, cosequently its inductance is high compared with its resistance and its power factor at the start is correspondingly low. The starting winding is comparatively light and of high resistance. The resistance is therefore the predominant characteristic of this winding. The power factor is correspondingly high and the currents in the two windings are out of phase by a considerable angle thereby producing a rotating field sufficient to start the rotor.

The relative use of turns of the main and starting winding depends on the design. If the machine is designed for a high starting torque, the wire in the starting winding will be large and will have a lesser number of turns. The electrical characteristics and the size of wire in the starting windings may thus vary greatly in two machines of the same rated horsepower and speed.

The stator poles are wound with pyramidal coils, the wire being threaded into the slots from spool or spools or they may be wound by the less expensive skein method.

An automatic centrifugal switch serves to open the starting winding after approximately one-half speed has been attained.

Rotors of the squirrel cage type are used, although in some of the larger sizes, to insure good starting torque with minimum current, combinations of the squirrel cage and phase winding are extensively used.

With the split phase type of motor, clutch pulleys are generally used on account of the inherently poor starting torque as compared with other types.

The resistance reactance type of motor is virtually a three-phase squirrel cage induction motor in which an imperfect three-phase rotating field is produced by the use of a non-inductive resistance and reactance connected in the stator circuit while starting. The starting torque of these motors also is inherently limited.

For many power requirements on single phase circuit which demand a specially good starting torque with minimum current we have one form of repulsion motor, due to Latour, which possesses a combination of series and shunt characteristics; namely, a limited speed with increase of torque with decrease of speed. To secure the necessary torque in the straight repulsion motor, a direct current armature is placed in a magnetic field and short circuited through brushes set with a predetermined angular relation to the stator field. To further improve the operating characteristics of the plain repulsion motor a second set of brushes, viz. the compensating brushes, is placed at 90 electrical degrees from the main short circuiting or energy brushes. These compensating brushes are connected to a winding in the main field of the motor, this winding may be either the center section of the main winding as in a compensator or separate coils wound concentric with the main field. The purpose of the compensating winding are, first, to secure a reasonably constant speed independent of the load and, second, to obtain high power factors. In these motors the power factor is very good under all conditions and the greater portion of the exciting current is supplied from the compensating circuits, thus relieving the main winding from the necessity of furnishing this current. When used on variable speed works a variable resistance is inserted in the energy circuit.

Of the several other more or less modified forms of repulsion motors that should be mentioned before closing is the one due to Mr. Val Fynn of England, the main structural departure in this motor is that two windings are employed on the rotor. The main or principal winding is the usual well known squirrel cage type and occupies the bottom of the slots. The second or auxiliary winding is of the usual commuted type, is connected to the commutator and occupies the top of the slots. Between the two is placed a magnetic separation in the form of a steel bar. The brushes and windings on the frame are similar to the ones on the motor last mentioned but the connections are slightly different. Its action is as follows: At starting the commuted winding is connected in series with the main stator winding and across the mains. A small automatic centrifugal switch provided serves to connect the compensating winding to the brushes after sufficient speed has been reached. This automatic switch is not essential to the operation of the motor but does serve the purposes by cutting in the compensating winding to improve the power factor and slightly improve the efficiency in the running condition.

This motor as commercially manufactured has a leading power factor at light loads and a substantially unity power factor from half load to 50 per cent overload. It is also adaptable to variable speed and has been in practical commercial use for sometime in a few of the European countries, although not extensively as yet in this country.

COMPLAINTS.

BY GEORGE DICHLMAN[1]

It must be apparent to all executives of public service institutions that they can hope for a square deal from the voter only when they deserve it. When convinced that the corporations, in their dealings with him, are sincerely endeavoring to serve and please as do the grocer and other merchants, the voter will be less eager to allow the political agitator to influence him. He will more readily appreciate the fact that his interests are identical with those of the corporations and will select public officials from the ranks of business men, wide in commercial experience, broad in their views, possessing true public spirit and fair in their official acts when regulating the conduct of the utility corporations.

It has been demonstrated in several instances in public utility history, that the average citizen is fair-minded. Upon receiving the treatment expected from corporations, he in turn will show his appreciation by upholding them in their contentions. Is it not possible that much of the adverse legislation in recent years is due to unconscious neglect upon the part of public utility executives when dealing with their customers; by not giving more personal attention to the handling of their grievances? These seemingly unimportant details, when not placed in competent hands, are mismanaged, and become, in the aggregate, weighty factors in creating an unfriendly attitude toward public service corporations.

Serving, as they do, the majority of the people, it might behoove gas managers to do their duty toward helping the citizen tide over this stage of more or less blindly radical legislation, by giving more personal attention to his grievances. When the professional politician denounces corporations, among those contributing the heartiest applause is the same citizen who has a kick against the gas company. The housekeeper with a high bill, who has been granted the use of the ballot in several of the states, will not be slow in venting her ire upon the heads of corporations in general for taking such a slice out of her household allowance—the grievance of the male voter is of no greater importance.

We know that the gas company employe, coming in contact with these voting customers, is unconscious-

[1]New Business Department, Western States Gas and Electric Company, Stockton, Cal.

ly instrumental in molding public opinion. Upon his conduct, depends to a large extent, the good or ill-will of the public towards the company. By overlooking the least opportunity to please the customer, he can, in a measure, undo the plans of the executive in his work of forming a good service organization.

Of all departments coming in contact with the public, the one handling the complaints of high bills seems the most important. The essential thing to be desired, is to attend these complaints in such a manner as to leave the customer with no ill feeling toward the company. The men at the windows receiving the cash, and those adjusting the complaints can do a great deal to accomplish this essential good feeling. It is these men, together with the employes doing the outside work, who are the "gas company," according to the great majority of the customers; even more than the manager, whose executive duties allow him to meet only a small minority of the consumers.

In attending to complaints of high bills, are gas companies generally as progressive as they might be? Considering the fact that the good will of the people largely depends on the proper treatment of their grievances, imaginary or otherwise, is it not desirable to give them every attention? Among these, the complaint of a high bill perhaps ranks first, as this amounts to a matter of dollars and cents to the customers. Most gas men realize the amount of ill will created by one of these complaints if not properly taken care of.

The more up-to-date managers have adopted a plan of isolating the complaint department, placing it in charge of a competent man, who endeavors by close questioning, comparison with previous bills, testing and explaining operation of meters, to convince the customer that the gas bill is correct. Some managers increase the efficiency of the department by sending demonstrators to call at the home and show the customers how to economize. This accomplishes better results.

While, in this manner, a good percentage of complaints are taken care of, those who have watched this department have noticed that many complaining customers leave the office apparently calmed, but who feel that in some way the hands on the dials of the meters might have indulged in a race with one another. These customers pay their bills under a silent protest, the department has failed to accomplish its purpose.

In many cases, the office man, reaching the end of his resources in reasoning with the customer, offers to test the meter. Although meters should be tested regularly, regardless of complaints, can we not question the advisability of testing because of the high bill before we have made further investigation? Upon close observation, we are lead to believe that this action is not effective. The customer is apt to think that the company is in doubt as to the accuracy of the meter. Even when shown that it tested O. K. some feel that they were hoodwinked in some way.

Another objection to this method is, that in spite of the isolation of the investigation department, if more than one complaining customer is in there at the same time, as is so often the case during the rush, those waiting their turn are sure to talk over their troubles with each other, and thereby each gains the impression that complaints are general. "Everybody is kicking." Again, if kept waiting any length of time, they are in no fit frame of mind to be dealt with, thus making it more difficult to reason with them.

Again, the office man cannot convince a large proportion of the complaints that the big bill is really their own fault. Not being at the seat of the trouble, and therefore not conversant with the local conditions, he is more or less at a disadvantage.

In view of the above facts, it seems reasonable to believe that we should arrange to get them out of the office, away from the rest of the customers.

Regarding the plan of sending a demonstrator to the home, let us again question: Is it a good policy to send a lady demonstrator out on these complaints? Valuable as we all know the demonstrator to be in her other lines of work, we are inclined to believe that, for several reasons a man can accomplish better results. For this particular work, it is essential that a competent person should be secured. Not an inexperienced clerk or the average stove man, but one, who, besides having considerable experience handling customers, is thoroughly familiar with the operation of gas appliances, and has a fair knowledge of how they should be operated economically. It is preferable that he be mature in years, that he may command respect.

After a recent experience, I am inclined to believe that we can bring about more effective results by adopting another plan. In one of the Byllesby properties, recently acquired, we worked with the office complaint man, and tried the experiment of taking the customer aside, and in a kindly manner stated that we were sorry to hear his bill was high, and that we would give him or her our immediate attention, and would call at the house to see what was wrong. Almost without exception, and without attracting the attention of other customers the complaint was thus temporarily disposed of in a peaceable manner. Most customers seem to prefer this plan, because they leave the office with the intention of telling their trouble when they get a representative of the gas company in their home.

We would call at the house as soon as possible, preferably in the forenoon, stating that the manager personally sent us to find out the trouble. We found the customer in a more receptive frame of mind—she was in her own home instead of in the gas office. This time of day nearly every housekeeper was using some part of her range. In many cases, she was caught redhanded wasting gas in some manner easily detected. This gave us considerable advantage. By asking questions in a kindly way, we would generally find that they were wasting gas either at the range or water heater. After showing how important small economies were in the aggregate, we came to the most important part of the procedure, viz: Teaching the customer to read her own meter. The talk went something like this: "Mrs. Smith, I believe that, if you will help me, we can materially cut down the big bill. First, if you will come to the meter with me, I'll show you how to read it, so that you need not depend on our man. You can figure out your own gas bill. It's so easy a ten-year-old child can do it. You check up your other household bills each month, why not your gas bill?"

The housekeeper did not resent this sort of talk.

That enormous gas bill was fresh in her mind. The fact that we called, and thereby showed a personal interest, in her, convinced her that we were sincere in our efforts, and that it might be to our interest to go to this bother. She was taught to read the meter, and then taken back to her kitchen and something like this followed: "Now, Mrs. Smith, while I am here, I'll ask you to make a note of the date and statement of your meter, as you and I read it today, and I am going to adjust your appliances (or send a man tomorrow) and will you work with us to the extent of practicing the small economies I have suggested to you, for one week, and to be sure to again read your meter a week from today, and figure out how much gas you used during that time? Read it again two weeks from now, and compare the two amounts. See if you have been able to make the second week bills smaller than the first. If you should get confused in your figures, call me up, here's my card, and I'll set you right. If the two different weeks vary much, being only a few days back, it is fresh in your memory, and you can think back, and see where you have made a saving or where you used a little more gas than the week before."

Upon leaving, nearly every customer thanked me for calling and promised to watch the range and the meter. I have closely observed the results of this method, and find it to be most successful in making a friend for the company, and permanently disposing of the complaint. Handled in this manner, a very small proportion of the customers ask to have their meters tested.

Is this a more expensive way of accomplishing results? Granting the extra cost of handling complaints in this manner, over the plan of promiscuous testing of meters, is not this expense justifiable, when we consider that we have obtained far more satisfactory results?

It has been my observation that complaints handled in this way are appreciated by the customer. It converts a "knocker" into a "boosting" housekeeper, a gas company's most valuable asset.

TROUBLE DATA REPORTS IN SAN DIEGO.

The investigation department of the San Diego Consolidated Gas and Electric Company is alive to collecting every available piece of information which may lead to a reduction of complaints. An automobile is kept ready at any instant to speed away for the relief of some customer should complaint in the service arise at any time. Below is a copy of the interesting leaflet which is filed away upon the return of the investigator in the case of a call to examine a consumer's service.

A careful glance at the data called for on this investigation order gives a comprehensive idea of the minute compilation of details undertaken by this utility company in diminishing the number of complaints. At stated intervals the different answers are tabulated and by this means the one having this work in charge can far more accurately judge from which source the complaints arise and often thus handle a whole series of complaints by reducing to a minimum a common defect causing the complaints to arise.

Form 117—8-11—6M—F. & S.

B San Diego Consolidated Gas & Electric Company

GAS

Nº 22763 **INVESTIGATION ORDER**

Date .... 191.....

Name ....

Address ....

Meter Number ....

Test Meter ....

Re-read Meter ....

No Gas ....

Poor Pressure ....

Place Rec. Pres. Gauge ....

Adjust Range .... *W. H.* .... *Lights* ....

Trace Piping ....

Misc. ....

....

This investigation is being made at {VERBAL / WRITTEN / PHONE} *request*

of .... 191.....

Investigate promptly and report fully in blank spaces hereon, to the undersigned.

By ....

REPORT

Meter Number ....

Index ....

Remarks ....

....

....

Received .... A. M. / P. M. *Arrived* .... A. M. / P. M. *Departed* .... A. M. / P. M.

Date Completed .... 191.....

By .... *Meterman*

REPORT

Is the pressure O. K.? ....

Is piping gas-tight? ....

Are meter connections O. K.? ....

Location of leak, if any? ....

....

Rate of leak? ....

No. of gas jets used? ....

What kind of burners? ....

Condition of burners? ....

....

Has consumer a gas range? ....

What kind? ....

Condition? ....

Has consumer a hot plate? ....

What kind? ....

Condition? ....

Has consumer a gas water heater? ....

What kind? ....

Condition? ....

Has consumer a gas heating stove? ....

What kind? ....

Condition? ....

Other appliances in use? ....

....

Is there any unnecessary waste of gas; if so, where? ....

....

....

....

....

What can you suggest to better the service and avoid the waste of gas? ....

WESTERN LAWS OF ELECTRICITY AND WATER

WATER RIGHTS ON INTERSTATE STREAMS.

BY A. E. CHANDLER.

The principles of either the doctrine of riparian rights or of that of prior appropriation have been thus far considered as developed within the various western states and no mention has been made of the right to use the waters of interstate streams. A little consideration only is necessary to recall to one the great number of rivers which either flow from state to state or form the boundary line between them. The Snake from its headwaters in the mountain lakes of Wyoming meanders across Idaho, crosses and re-crosses the Idaho-Oregon boundary line, flows through southeastern Washington and finally joins the Columbia, which is the boundary between Washington and Oregon. The tributaries of the Missouri rise in Wyoming and the main stream flows through or touches Montana, North Dakota, South Dakota, Nebraska and Kansas. The principal tributaries of the Colorado, the Green and the Grand, rise in Wyoming and after their confluence in Utah the main river flows into Arizona and becomes the boundary between Nevada and Arizona, and also between California and Arizona. The Rio Grande rises in Colorado and flows through New Mexico into Texas.

The waters of all of the great rivers mentioned are used to some extent in irrigation but with the exception of the Rio Grande, and possibly the lower Colorado, there is no likelihood of trouble in the near future between states regarding their use. The interstate streams which have been in controversy are the small mountain tributaries whose small flow was early appropriated. On such streams it is very common to find ditches heading in the upper state and irrigating lands in both the upper and lower states. Willey v. Decker (73 Pac. 210) dealt with Young's Creek flowing from Montana into Wyoming and back again into Montana, and the Supreme Court of Wyoming therein held (as reported in a head note):

> In the absence of statutory provisions, owners of land in Montana may acquire a legal right by prior appropriation to the use of the waters of a stream having its source in that state, and flowing thence * * * in Wyoming, by joining with owners of land in Wyoming in the construction of a ditch, and thereby diverting the waters of the stream at a point within Wyoming for the irrigation of lands in Montana and Wyoming.

Sage Creek is another small stream rising in Montana and flowing into Wyoming. In Howell v. Johnson (89 Fed. 556) the defendants contended that the plaintiff, having a water right under the laws of Wyoming, could not have a federal court enforce the same, and also that the rights to water were under the control of the legislature of Montana. The court, however, applied the doctrine of appropriation regardless of state lines and held for the plaintiff—diverting in the lower state, Wyoming. The lower prior diversion was likewise protected in Hoge v. Eaton (135 Fed. 411) wherein appropriators from Sand Creek in Wyoming complained of a later diversion of the creek in Colorado. The court therein said:

> The right to divert running waters for irrigating lands in an arid country is not controlled or affected by political divisions. It is the same in all states through which the streams so diverted may pass.

The waters of Sage Creek were again in controversy in Bean v. Morris which was decided by the United States Supreme Court May 29, 1911 (221 U. S. 485). The Supreme Court therein said:

> But with regard to such rights as came into question in the older states, we believe that it always was assumed, in the absence of legislation to the contrary, that the states were willing to ignore boundaries, and allowed the same rights to be acquired from outside the state that could be acquired from within. * * * * * There is even stronger reason for the same assumption here. Montana cannot be presumed to be intent on suicide, and there are as many if not more cases in which it would lose as there are in which it would gain, if it invoked a trial of strength with its neighbors. In this very instance, as has been said, the Big Horn, after it has received the waters of Sage Creek, flows back into that state. But this is the least consideration. The doctrine of appropriation has prevailed in these regions probably from the first moment that they knew of any law, and has continued since they became territory of the United States. It was recognized by the statutes of the United States, while Montana and Wyoming were such territory, * * * and is recognized by both states now. Before the state lines were drawn, of course, the principle prevailed between the lands that were destined to be thus artificially divided. Indeed, Morris had made his appropriation before either state was admitted to the Union. The only reasonable presumption is that the states, upon their incorporation, continued the system that had prevailed thereofore, and made no changes other than those necessarily implied or expressed.

The cases thus far referred to did not raise the doctrine of riparian rights, although it is thought to still exist in Montana. The conflict of doctrines was before the Federal Circuit Court in Anderson v. Bassman (114 Fed. 14) wherein the plaintiffs were farmers using the waters of the West Carson River in Nevada and the defendants were irrigators from the same stream in California. In the decision Judge Morrow points out that the doctrine of appropriation is alone recognized in Nevada while California uses the dual system of appropriation and riparian rights. On account of the conflict of accepted systems no attempt was made to ascertain individual rights of priority but the case was decided by allowing the farmers in California the use of the entire stream for five days out of ten and a like use to those in Nevada.

Kansas v. Colorado.

By far the most important case dealing with the use of the waters of an interstate stream is Kansas v. Colorado (206 U. S. 91) decided by the United States Supreme Court May 13, 1907. It was initiated on May 20, 1901, by Kansas charging Colorado with the wrongful diversion of the waters of the Arkansas River. On May 21, 1904, the United States intervened in behalf of its operations under the Reclamation Act of June 17, 1902.

Kansas claimed that the waters of the Arkansas should be allowed to flow as they were accustomed to flow, and that by the diversions in Colorado not only

were the property owners along the river deprived of its surface flow but all land owners within the drainage area were deprived of the beneficial influence of the subterranean flow.

Colorado contended that under the provisions of its constitution it is the owner of all waters within its borders. It further contended that the Arkansas River is substantially two rivers—the Colorado Arkansas rising in the Rocky Mountains and sinking, in times of low water, in the sands of Western Kansas, and the Kansas Arkansas which is formed by springs and surface drainage in Western Kansas east of the sink of the Colorado Arkansas.

The United States in its petition in intervention sets forth the vast acreage of public lands to be reclaimed under the provisions of the Reclamation Act, the reliance of the arid west upon the doctrine of prior appropriation, the inapplicability of the riparian doctrine where irrigation is necessary, the contention of Kansas that it is entitled to have the waters of the Arkansas flow uninterrupted and unimpeded into Kansas, the contention of Colorado that it is the owner of all waters within the State, and closes with the following:

> That neither the contention of the State of Colorado nor the contention of the State of Kansas is correct; nor does either contention accord with the doctrine prevailing in the arid region in respect to the waters of natural streams and of flood and other waters. That either contention, if sustained, would defeat the object, intent, and purpose of the reclamation act, prevent the settlement and sale of the arid lands belonging to the United States, and especially those within the watershed of the Arkansas River west of the ninety-ninth degree west longitude, and would otherwise work great damage to the interests of the United.

Justice Brewer, who wrote the opinion, after showing that the case is one over which the Supreme Court has jurisdiction said:

> Turning now to the controversy as here presented, it is whether Kansas has a right to the continuous flow of the waters of the Arkansas River, as that flow existed before any human interference therewith, or Colorado the right to appropriate the waters of that stream so as to prevent that continuous flow, or that the amount of the flow is subject to the superior authority and supervisory control of the United States. * * * * * Is the question one solely between the states or is the matter subject to national legislative regulation, and, if the latter, to what extent has that regulation been carried? * * * * The primary question is, of course, of national control.

The power of congress to preserve the navigability of streams is first examined with the conclusion:

> It follows from this that if in the present case the national government was asserting, as against either Kansas or Colorado, that the appropriation for the purposes of irrigation of the waters of the Arkansas was affecting the navigability of the stream, it would become our duty to determine the truth of the charge. But the government makes no such contention. On the contrary, it distinctly asserts that the Arkansas River is not now and never was practically navigable beyond Fort Gibson in the Indian Territory, and nowhere claims that any appropriation of the waters by Kansas or Colorado affects its navigability.

The court then proceeds to examine "the question whether the reclamation of arid lands is one of the powers granted to the general government," pays particular attention to that part of section three of article four of the constitution reading: "The congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States * * *," and concludes that the section grants to congress no legislative control over the states, but gives it authority over federal property within their limits. It is stated that the constitution is silent regarding the reclamation of arid lands as no such problem existed at the time of its adoption, that with the extension of national territory large areas of arid lands have been included, and that "it may well be that no power is adequate for their reclamation other than that of the national government. But if no such power has been granted, none can be exercised."

It is the last sentence quoted which has led many to believe that the Supreme Court in this case declared the Reclamation Act unconstitutional. The validity of that Act, however, was not in issue, but the question of national control—that is, the superior right of congress to legislate regarding the reclamation of arid lands—was. This should be clear from the following quotation which is from the paragraph immediately following the sentence referred to:

> It does not follow from this that the national government is entirely powerless in respect to this matter. These arid lands are largely within the territories, and over them by virtue of the second paragraph of section three of article four heretofore quoted, or by virtue of the power vested in the national government to acquire territory by treaties, congress has full power of legislation, subject to no restrictions other than those expressly named in the constitution, and, therefore, it may legislate in respect to all arid lands within their limits. As to those lands within the limits of the states, at least of the western states, the national government is the most considerable owner and has power to dispose of and make all needful rules and regulations respecting its property. We do not mean that its legislation can override state laws in respect to the general subject of reclamation. While arid lands are to be found, mainly if not only in the western and newer states, yet the powers of the national government within the limits of those states are the same (no greater and no less) than those within the limits of the original thirteen, and it would be strange if, in the absence of a definite grant of power, the national government could enter the territory of the states along the Atlantic and legislate in respect to improving by irrigation or otherwise the lands within their borders. Nor do we understand that hitherto congress has acted in disregard to this limitation.

After quoting from Gutierres v. Albuquerque Land Company (188 U. S. 545) the court continues:

> But it is useless to pursue the inquiry further in this direction. It is enough for the purposes of this case that each state has full jurisdiction over the lands within its borders, including the beds of streams and other waters. * * * * It may determine for itself whether the common law rule in respect to riparian rights or that doctrine which obtains in the arid regions of the West of the appropriation of waters for the purposes of irrigation shall control. *Congress cannot enforce either rule upon any state.*

It is certain from the above that the state and not the nation is superior regarding legislation concerning the use of public waters not navigable. As stated, the Supreme Court believed it to be the "primary question" involved in the case and, after such careful and direct consideration, the decision must be accepted as final.

Coming to the direct issue between the two states, it is held that the dispute must be so adjusted "upon the basis of equality of rights as to secure as far as possible to Colorado the benefits of irrigation without

depriving Kansas of the like beneficial effects of a flowing stream." Tables are set forth in the opinion showing the increase in population, acreage irrigated, and value of farm products in the counties of eastern Colorado traversed by the Arkansas River. The court comments on the marked development thus evidenced and says that, as shown by the testimony, it is undoubtedly due to irrigation. A like examination is made of the census statistics for the counties of western Kansas with the conclusion that the use of the water in Colorado has not been of serious detriment to such counties.

The substance of the decision is well presented in the following paragraphs:

> Summing up our conclusions, we are of the opinion that the contention of Colorado of two streams cannot be sustained; that the appropriation of the waters of the Arkansas by Colorado, for purposes of irrigation, has diminished the flow of water into the State of Kansas; that the result of that appropriation has been the reclamation of large areas in Colorado, transforming thousands of acres into fertile fields and rendering possible their occupation and cultivation when otherwise they would have continued barren and unoccupied; that while the influence of such diminution has been of perceptible injury to portions of the Arkansas Valley in Kansas, particularly those portions closest to the Colorado line, yet to the great body of the valley it has worked little, if any, detriment, and regarding the interests of both states and the right of each to receive benefit through irrigation and in any other manner from the waters of this stream, we are not satisfied that Kansas has made out a case entitling it to a decree. At the same time it is obvious that if the depletion of the waters of the river by Colorado continues to increase there will come a time when Kansas may justly say that there is no longer an equitable division of benefits and may rightfully call for relief against the action of Colorado, its corporations and citizens in appropriating the waters of the Arkansas for irrigation purposes.
>
> The decree which, therefore, will be entered will be one dismissing the petition of the intervenor, without prejudice to the rights of the United States to take such action as it shall deem necessary to preserve or improve the navigability of the Arkansas River. The decree will also dismiss the bill of the State of Kansas as against all the defendants, without prejudice to the right of the plaintiff to institute new proceedings whenever it shall appear that through a material increase in the depletion of the waters of the Arkansas by Colorado, its corporations or citizens, the substantial interests of Kansas are being injured to the extent of the destroying the equitable apportionment of benefits between the two states resulting from the flow of the river.

It must be emphasized that the Supreme Court in its decree did not attempt to make an equal division of the waters of the stream, but rather an equitable apportionment of benefits. Neither the rule of prior appropriation nor that of riparian ownership is followed, but the case is allowed to rest on the "cardinal rule of equality of right"—not to the means but to the results.

Legislation Regarding Interstate Streams.

In 1911 California enacted legislation making it unlawful to transport the waters of any lake or stream of the state "into any other state, for use therein." Colorado in the same year authorized a joint legislative committee to investigate the interference by the federal government or any state, corporation or individual with the control by Colorado of the waters within its borders. Wyoming, likewise in 1911, authorized its attorney general, under the direction of the governor, to bring such actions "as he may deem expedient to maintain the rights of the state and its citizens in the waters of interstate streams."

The only state which provides by statute for the recognition of diversions from interstate streams is Oregon. By the Act of February 23, 1911, it is provided that no permit for the appropriation of water shall be denied because the point of diversion, or any portion of the works, or the place of intended use, or any lands to be irrigated may be situated in some other state; "provided, however, that the state engineer may in his discretion, decline to issue a permit where the point of diversion described in the application is within the State of Oregon but the place of beneficial use in some other state, unless under the laws of such state water may be lawfully diverted within such state for beneficial use in the State of Oregon."

Legislation similar to that of Oregon should be enacted by all the states where rights are initiated by an application to the state engineer. Cases are constantly arising where applications are made for proposed systems lying partly within two states. Without definite legislation the state engineer has no guide to action—some engineers have approved such applications, others have rejected them. In New Mexico the territorial engineer approved an application for the irrigation of lands in New Mexico by a ditch heading in the Animas River in Colorado about six miles above the interstate line. The matter reached the courts and the Supreme Court of New Mexico decided that "the territorial engineer was without authority to approve the application in question." (Turley v. Furman, 114 Pac. 278, decided March 4, 1911).

Not only is legislation necessary in regard to the initiation of rights for interstate ditches in order to protect the one so appropriating water, but it is badly needed in the interest of the general public in dividing the public waters among ditches entitled thereto. At present the only means provided by statute for distributing the waters of streams is the authority given the water commissioners, or water masters, to close, or partly close, headgates so that the later and upper ditches cannot take the waters belonging to prior appropriators. As such officers cannot act beyond the borders of their state they are powerless to control a ditch heading above their state line. The state engineer of Nebraska reports that one ditch diverting water from the North Platte in Nebraska near the state line was extended so that it headed in Wyoming about two hundred feet above the state line. It thereupon proceeded to take all the water desired while the ditches heading below in Nebraska and having earlier rights had their supply regulated, and in some cases entirely cut off, by the state officials in charge.

To remedy this condition the state engineer of Nebraska has recommended "that every canal flowing into this state have a controlling gate and measuring flume just within the state and in addition thereto a return canal whereby the water sought to be appropriated may flow back to the stream from which diverted." Other state engineers have made similar

suggestions. In many cases the construction of a "return canal" would necessitate heavy expenditures and appear prohibitive, but the situation on many streams is sufficiently serious to warrant drastic action.

The 1911 California legislation referred to above is copied from a statute adopted in New Jersey in 1905. The constitutionality of the latter was upheld by the United States Supreme Court in Hudson Water Company v. McCarthy (209 U. S. 349). It is specifically stated in the opinion therein, however, that "The problems of irrigation have no place here * * *," so the decision will not necessarily control in attacks upon the validity of such statutes in the western states. In further support of their validity it is important to note that most of the earlier decisions regarding rights on interstate streams lay down the rule of prior appropriation regardless of state lines in the absence of statutory provisions to the contrary. The argument against such prohibitive legislation must be based on reasons of policy rather than those of law. As suggested in the quotation from Bean v. Morris above, each state stands to lose just as much as it can gain by such statutes.

Summary.—From a consideration of the cases dealing with interstate streams (the leading ones only being mentioned above) the following conclusions are justified. The state and not the nation is superior regarding legislation concerning the use of public waters, excepting only the matter of navigation wherein the nation controls. Between private appropriators in two states recognizing only the doctrine of prior appropriation it is very probable that that doctrine will be applied regardless of state lines. Between private appropriators in two states, one or both of which recognize the doctrine of riparian rights, the priority of appropriations will not be established, but the waters will be distributed on an attempted equitable basis suggested by the particular facts of the case. In a controversy between two states in their soverign capacities the principle established in Kansas v. Colorado will undoubtedly be applied, and the Supreme Court will decide in accordance with what the facts of the case indicate to be an equitable apportionment of benefits. Legislation forbidding the diversion of waters from within a state to another state is probably legally sound but is based upon such shortsighted policy that it cannot prevail.

PINK SPECIAL TRAIN de LUXE.

The above is a picture of the "Pink Special" train de Luxe enroute to the N. E. L. A. convention at Seattle over the Canadian Pacific as it appeared at East Pittsburg, where a delegation from the Westinghouse Electric & Manufacturing Company met them.

Two very pretty young ladies dressed in pink presented each lady on the train with carnations, the Westinghouse Band, composed of employees of the company, enlivened their trip with popular airs until they reached the Union Station.

A handsome album containing scenes en route was presented to each member by the Westinghouse Electric & Manufacturing Company. Song books were also distributed. The General Electric Company also presented each of the travelers with a most tastefully gotten up leather-bound booklet containing views of natural scenery and industrial plants along the route.

The master of transportation of this train was Mr. J. C. McQuiston, manager of the Westinghouse Department of Publicity.

"Pink Special."

The personnel of the train was as follows: Past presidents W. C. L. Eglin, Philadelphia, Pa., and Mr. Dudley Farrand, Newark, N. J., Messrs. S. L. Tone and R. S. Orr, vice-president and superintendent, respectively of the Allegheny County Light Company. Among the others were: Messrs. S. L. Nicholson, G. B. Griffin, E. A. Thornwell, G. C. Ewing, B. F. Ott, Van Dusen Rickert, E. E. Gilbert, F. D. Pembleton, A. E. Clifford, J. C. Woodsome, R. E. Hamilton, R. B. Parker, David B. Rushmore, John Mustard, R. E. Moore, D. A Bertolette, Mr. and Mrs. C. S. Cook, Mr and Mrs. Harry M. Hope, Mr. and Mrs. Farley Osgood, Mr. and Mrs. W. K. Vanderpoel, Mr. and Mrs. M. O. Troy, Mr. and Mrs. Dudley Farrand, Mr. and Mrs. Paul Spencer, Mr. and Mrs. Marlow, Mr. and Mrs. L. E. Sinclair, Miss Jane Eglin, Mr. and Mrs. J. J. Gibson, Mr. and Mrs. John L. Mather.

N. E. L. A. CONVENTION AT SEATTLE.

The Fifth Annual Convention of the National Electric Light Association has been a brilliant occurrence during the past week at Seattle. Commencing on Sunday, when the special trains from the four corners of America began to arrive at the Convention City, there has been a continuous procession of welcomes, bounteous hospitality and technical and commercial meetings.

The six prismatic-hued special trains, each given a distinguishing color, were made up of the finest equipment in operation in America. On all of them the trips were made enjoyable by unique entertainments, elaborate hospitality at the various points en route, and it was invariably a happy crowd which was met at Seattle by the committees in charge.

The Golden Poppy Special, which carried the California delegates, like the rest of the specials, was given right of way over everything on the road and arrived according to schedule. Those who were fortunate to travel by this train all agreed that the trip was the most enjoyable ever taken.

On Monday afternoon, there was a baseball game in which the Pacific Coast team won over the Easterners by a score of 16 to 3. On the evening of that day an elaborate reception and ball was given. The real

work of the Convention commenced on Tuesday morning with an address of welcome by Mayor Cottrell of Seattle. This was followed by the annual address of Presiding Officer John F. Gilchrist of Chicago, after which Mr. Gilchrist introduced Mr. John A. Britton, vice-president and general manager of the Pacific Gas and Electric Company of San Francisco, who delivered an elaborate plea for the recognition of San Francisco in 1915.

In introducing Mr. Britton, the president said:

"All of you know San Francisco, and those of you who have not enjoyed the experience, have heard of her unbounded generosity and hospitality. That is my excuse for calling before you a man from San Francisco who is a director of the Exposition. We understand he has some good message to deliver to us."

Mr. Britton's plea for San Francisco was enthusiastically received and brought the Convention to its feet.

Among the things he said were the following sentences:

"I want to dissociate myself for one moment from my role of delegate, and in assuming that of an officer of the Exposition Company to give you this message: 'San Francisco invites the world in 1915.' In giving you that message, I wish to remind you that San Francisco is representing the entire United States in this commemoration of the greatest engineering feat ever done by man. California is the pioneer, not only in central station development, but also in the hydroelectric transmission development systems to be operated in this country."

He then discussed the potential feature of San Francisco, and especially in connection with the Exposition, giving a description of the many congresses which will be held there in 1915. Finally, he said:

"I care not whether you visit the orange vales of Los Angeles, seek the shelter of the mountains of Siskiyou, or climb the Sierra Nevadas, eventually you will gravitate toward San Francisco, the city on the bay that furnishes the finest harbor in the world, where peace and plenty abound and where we will do all we can for you in 1915. Come, I pray you."

In reply to Mr. Britton's splendid plea, President Gilchrist stated that while at present it was not a time for deciding where the 1915 Convention would be held, he would assure Mr. Britton and the Fair directorate that the request which had been so eloquently presented would be seriously considered.

The general, executive, technical, accounting, commercial power transmission and public sessions commenced immediately following the general addresses, there being three sessions held at 2:30p.m..in which the various reports of committees were made. Three papers were delivered on the general subject of accounting and two papers and several reports made in the technical session.

On Tuesday evening the transmission session was opened by an address by Mr. Henry L. Doherty in a report on "The Use of Electricity for Irrigation and Agricultural Purposes," illustrated by lantern slides and moving pictures. There was also a commercial session at which various reports were presented.

On Wednesday morning occurred the second general session with several papers, also an executive session and the second technical and accounting sessions with several important papers.

Wednesday afternoon the various morning sessions were continued, in which a great deal of work was done, and on Wednesday evening there was a musical program and an illustrated lecture on the "Electrification of the Panama Canal." On Thursday were the concluding sessions of the various departments and a number of papers were given.

Throughout the week the Seattle hosts outdid themselves in the variety and elaboration of entertainment offered. Trips were made to the various hydroelectric plants and to many other interesting points, and much entertainment was offered to the ladies who did not care to attend the various meetings of the Association.

This Convention is conceded to have been one of the most successful ever held by the National Electric Light Association and universal praise is conceded to the Seattle members.

DISTRIBUTION OF POWER FROM LOS ANGELES AQUEDUCT.

Electrical Engineer Scattergood has presented plans for the distributing system of power from the Los Angeles Aqueduct. These plans divide the city into five districts, with an aggregate of 1068 miles. The total cost of an underground system as figured by Scattergood is placed at \$16,574,500, while the total overhead system is fixed at \$2,868,000.

The underground system estimates the cost of commercial lines and equipment at \$12,754,300, and the cost of street lighting at \$3,820,200. The overhead system places the commercial lines at \$1,618,000 and the street lighting system at \$1,250,000.

The districts are designated as 0, 1, 2, 3 and 4. The estimate per front foot for district 0 is 62 cents; for district 1, 66.1 cents; for district 2, 32.6 cents; for district 3, 35.8 cents; for district 4, 34.5 cents.

The districts are as follows: District 0: Beginning at Pico and Flower, on Pico to Wall; Wall to Fifth, Fifth to First, First, to Alameda, and return to San Pedro; thence to the Plaza, thence to New High street, New High to Temple, Temple to Hill, Hill to First, First to Olive, Olive to Fourth, Fourth to Flower, Flower to Pico.

District 1: Beginning at Sunset and Figueroa, on Figueroa to Washington, east to Central avenue, north to Third, east to Santa Fe avenue, north to Center street, north to Brooklyn avenue, west to Sunset and Figueroa.

District 2: Beginning at First and Hoover, south to Adams, west to Vermont, south to Santa Barbara, east to Main, north to Washington, west to Figueroa, north to First, east to Hoover.

District 3: Beginning at Hoover and Pico, west to Western avenue, south to Santa Monica avenue, west to city limits, south to Slauson avenue, east to Main, north to Santa Barbara, west to Vermont, north to Adams, east to Hoover, north to Pico.

District 4: Remainder of city not included in previous districts.

Numerous conferences will be held before the plan is finally adopted.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Water Rights on Interstate Streams

Maiandros was a river in Asia Minor. The classic Greeks told of how a hunter by that name chased a beautiful mountain nymph down from the high mountains and just as he was about to overtake her, the gods turned him into the river bearing this name. So circuitous was this mountain course taken by Maiandros in dodging here and there in his passionate pursuit, the name—meander—survives still, written indelibly into our language as signifying a zigzag or rambling course. To the Greek mind the coure of the Maiandros was the superlative of twisting and zigzagging.

We are not told in Indian traditions as to how our Western rivers were supposed to have been formed, but surely if a similar myth existed among them for the formation of the Columbia and its various tributaries, brave and passionate buck must have had many a dizzy turn before fair Red-wing was released in her flight at the entrance to the great Pacific.

Take, for instance, the waters of Silver Bow Creek, rising just east of Butte, Montana. In passing westerly through Montana this creek becomes the Deer Lodge, Hellgate, Missoula and Clark's Fork rivers. Under the latter name it drains into Lake Pond O'Reille in Northern Idaho. We next find the same waters journeying up into Canada, only to return into this country as the Columbia River, now wholly within the State of Washington, but later serving as the boundary line between Washington and Oregon. It may be remarked also in passing that countless smaller tributaries of the Columbia may be diverted from one State into another.

As the States through which these waters drain are semi-arid in character, the laws governing interstate streams are of vital interest.

A digest of the court decisions, many of which appear on another page of this Journal, and among which are cited several from our highest national tribunal, leads to five definite conclusions regarding water rights on interstate streams, as follows:

1. With the single exception of navigable streams the state and not the nation has jurisdiction over waters.

2. Regarding two appropriators, each situated on the same stream but in different states, wherein the doctrine of appropriation is upheld in both, priority of appropriation will be upheld regardless of state lines.

3. Regarding two appropriators, each situated on the same stream but in different states wherein either one or both states still adhere to the doctrine of riparian rights, the water will be distributed on an equitable basis, according to facts without considering priority of appropriation.

4. Regarding the rights of two states through which the same waters drain, the waters will be distributed on an equitable basis according to facts.

5. States may forbid by legislative action the taking of waters into other states. Without such legislation, however, waters may be conducted from the state.

Idaho at its last legislative session had up for consideration the forbidding of taking waters without the bounds of the state. Oregon passed a give and take or reciprocity law, while California, pursuing a narrow-minded policy passed a law forbidding the taking of waters without the state.

The distribution of waters of the West, like most of the other affairs of life, should be made on the

most liberal principles. Concerted action among the western states on a give and take basis is absolutely necessary for greatest good to all. It is to be hoped that other western states will soon follow the far-sighted policy inaugurated under Oregon's splendid water system and that California may soon come to its senses both as to diverting waters from the state and also as to adopting through liberal views of the courts the appropriation doctrine rather than the time dishonored system so far as western need are concerned—of the riparian doctrine.

New Coinage an Economic Necessity

Thos. N. McCarter, president of the American Electric Railway Association, in a recent after-dinner speech at the Palace Hotel in San Francisco forcefully summarized the three predominating evils or wrong viewpoints in the public mind that must be adjusted at once or stagnation and even possible chaos and dissolution may result to our great transportation companies of America. The most prominent of these three was shown to be the continual extension of the 5c fare limit in our city street railways with its ever-increasing transfer range.

Now comes the proposal to coin three-cent pieces and also a smaller unit to be known as the one-half cent piece. A bedlam of protest greeted this measure at its incipiency. The traction companies feared that when the coins became a reality the populace the country over would demand a three-cent car fare. The telephone company foresaw every nickel-in-the-slot machine bedecked with coins of the wrong denomination. And even the West—the dear old West—saw the possibility of one of its dearest traditions being swept away—that tradition which built up from bountiful days of forty-nine, makes the holder of each pocket book disdain the carrying or computing of accounts less than even multiples of 5c pieces.

As to the last argument, the gigantic commercial era now before the West has swept away this false hand-me-down of Western greatness and liberality, or if not entirely so it should. The economic age now upon us demands its abolition.

It appears that the telephone companies have nothing to fear from this new coin. It is said that the first thing the director of the mint, George H. Roberts, did after the proposed legislation was submitted to him for opinion, was to urge that the language of the bill be so shaped that the treasury could make the coin wholly unlike, in size and design, any existing coin. The design now most favored by the treasury is much too large to enter a dime slot, too small to operate a nickle slot and possesses a scalloped edge like an Indian one cent piece.

As to the protest from the traction companies regarding a three-cent fare, surely a rational, reasonable people will never unjustly demand the death of a prosperous, promising industry. This is an age of economy, an age of regulation and we believe in fair play. The rate question in the large city traction companies is indeed one of many complications and one that has been grossly mistreated and warped out of shape by both parties to the issue. After all the fundamental consideration is that of cost of service. If a careful investigation in any particular case should show that after allowing for interest, depreciation and all other operating expenses in spite of a reduction to a 3c or 4c fare, the earning on the securities can still be made to pay such a reasonable return that we would advise those nearest and dearest to us to invest their money in these securities, then by all means this should be done. On the other hand in communities where topographic features and other conditions are such that 6c is similarly necessary, then it is only reasonable that 6c should be charged. Both the traction companies and the people should forget the magic 5c piece, for it isn't magic.

It would seem that the traction systems have grown to such enormous proportions in our greater cities a zone system of charges should be made based solely upon cost of service from centers of distribution in these great municipalities. Simply because Los Angeles has had the nerve to extend its city limits by means of the shoe-string addition some sixteen miles westerly to the sea is no reason why the cost of service on a street railway over this sixteen miles should be but five cents. The zone system of charges seems to be the only rational method and to its careful study our great traction companies and the regulating commission should give most careful consideration. This consideration should be one absolutely independent of the 5c traditional coin handed down to us from an age wholly different from the present.

Electrical Education in 1915

The plea made by Mr. John A. Britton at the opening session of the National Electric Light Association in Seattle this week in which he mentioned California's supremacy in the development of electric power and transmission has really a far greater significance than may have been conceived, even by so brilliant a talker as he.

San Francisco is indeed a hub for the enormous potential activities of the Pacific Coast and it was to this city the first long-distance transmission system was developed. Every branch of electrical engineering practice may be observed and every step of the history of its development has been exemplified in the transmission systems connecting with the electrical supply of San Francisco.

The World's Fair in 1915 will far outshine in magnificence of display anything that has been heretofore conceived and it is all through the possibilities of the wonderful resources which have had their development in California. And the whole world has reason to expect such an exhibition, just as it might expect France to excel in silk textile exhibits, Persia in oriental tapestries, Germany in military organization, or Brazil in coffee and rubber. California can, however, go a step further, because while these various features of excelling are due more or less to local or sectional advantages, the development of the transmission and use of electricity is worldwide. Nevertheless, California keeps always ahead, her engineers answer the demand and fulfill the need without fear or favor. The world's greatest commercial science development will be found here in 1915.

PERSONALS.

J. T. Shaw, the telephone expert of the State Railroad Commission, visited Los Angeles during the past week.

W. S. Berry of Western Electric Company, has been enjoying a visit from his mother, Mrs. W. W. Berry.

H. V. Carter, president of the Pacific States Electric Company,, recently returned from an extensive eastern trip.

C. W. Hinchcliffe, who is now associated with independent telephone interests in Arizona and New Mexico, is at San Francisco.

E. V. D. Johnson, manager of the Northern California Power Company, spent the past week at Redding on an inspection trip.

Carlos De Muro, sales agent of the General Electric Company at Vera Cruz, Mexico, is visiting the Company's San Francisco office.

Chester H. Pennoyer, head of the National Conduit and Cable Company of California, has been confined to his home for more than a week.

Hurt Chipley of New York, counsel for the American Telephone and Telegraph Company, and Mrs. Chipley, are visiting San Francisco.

F. A. Richards, manager of the car department of Pierson, Roeding & Co., is spending a vacation in the Yosemite Valley, accompanied by Mrs. Richards.

C. B. Zabriskie, vice-president and treasurer of the United Properties Company, with headquarters at New York, is visiting the San Francisco office of the corporation.

H. L. Jackman, manager of the Western States Gas & Electric Company's Humboldt County interests, arrived at San Francisco from Eureka, during the past week, on his way north.

W. J. Davis Jr., Pacific Coast engineer for the General Electric Company, has just returned to San Francisco after visiting the works at Schenectady and spending a month in the East.

John S. Baker, district manager of the Crocker-Wheeler Company, spent the past week at Los Angeles, where an office was recently opened. **J. E. Fries**, Pacific Coast engineer, was at the San Francisco office during the absence of his chief.

H. A. Barre, chief electrical engineer of the Pacific Light and Power Company, is lying critically ill in a Los Angeles hospital. He submitted to an operation after breaking down with stomach trouble, while out on a survey for a new power line some time ago.

George H. Throop, engineer in charge of the valuation work undertaken by J. G. White & Company of New York for the San Joaquin Light & Power Corporation, has closed the Fresno office as the field work is completed, and removed his force to the Los Angeles office, where the data obtained will be worked up.

T. J. Pace, head of the arc light division of the Westinghouse Electric and Manufacturing Company of East Pittsburg, and **A. A. Brown**, assistant to the company's sales manager, with headquarters at New York City, spent a few days at San Francisco while en route to Seattle to attend the annual convention of the N. E. L. A.

C. A. S. Howlett, president of the National Sales Managers' Association, who is connected with the General Electric Company at Schenectady, was the guest of the San Francisco division for several days last week, while on an official visit to the Pacific Coast branches of the organization. On Thursday night Howlett was the guest of honor at a banquet at a cafe, where he addressed the local division on "The Importance of the Sales Department."

J. R. Freeman, a prominent consulting hydraulic engineer, who was retained by the city to make a report on the Hetch-Hetchy water project to the U. S. Army engineers, has arrived at San Francisco from the East. He has had his engineers on the ground for some time and they are now finishing the details of his plan. Freeman's report will be made up from data gathered by these engineers and from his own inspection of the water supply. It will be turned over August 1st to the Government officers.

STATE ELECTRICAL CONTRACTORS' ASSOCIATION.

H. C. Reid, manager of the electrical department of the Pacific Fire Extinguisher Company, is at Portland on business.

Bids have been received by the Board of Public Works from the various contractors for the electrical construction work on the car house for the Geary-street municipal railway, which is to be erected at an estimated cost of about $250,000. There were three separate propositions on the electrical work, including the wiring and switchboard for the lighting system of the car barn. The bids ran from $10,000 to $15,000, but no award has been made.

Bids have been taken by the United States Quartermaster's Department for the new feed wires for the electric system at the General Hospital at the Presidio, San Francisco. The bids were as follows: Newberry Bendheim Company, $9545; Butte Engineering Electric Company, $9693; the John G Sutton Company, $10,058; Standard Electrical Construction Company, $10,257; Turner Electrical Company, $10,220; McFell Electric Company, $10,495; Central Electric Company, $11,289. The bids have been forwarded to Washington, D. C.

ENTERTAINMENT OF THE RED SPECIAL TO THE N. E. L. A.

The Electrical Development League of San Francisco did itself proud in the entertaining during the past week of the New York delegation to the N. E. L.A. which has just concluded its sessions at Seattle.

From the time that the Secretary of the League boarded the train in Southern California to the final farewell as the train sped out from San Francisco to the North, there was something doing and something enjoyable for the guests every minute. The official program of entertainment began at 9 o'clock Thursday morning, June 6th. Ample automobiles were found in waiting at the St. Francis Hotel to convey the entire visiting delegation to the Exposition grounds and other points of interest in the Golden Gate City. An enjoyable forenoon thus ended at the Cliff House, where a delicately provided luncheon awaited the guests.

The reception committee having in charge the entertainment of the guests was composed of the wives of local men interested in the N. E. L. A. were as follows: Mrs. W. W. Briggs, chairman; Mrs. S. J. Lisberger, Mrs. F. H. Varney, Mrs. E. B. Strong, Mrs. Berry, Mrs. A. H. Halloran, Mrs. Robert Sibley.

After the luncheon at the Cliff House the guests were then provided with automobiles to be at their disposal for any purpose they desired throughout the afternoon.

The evening affair at the St. Francis was unique and full of ginger from start to finish. The Oriental and picturesque sight of dainty Chinese maidens sprinkling flowers among the guests was the starter, then followed some twenty Chinese boy musicians, American born, who by the rendering of such patriotism arousing songs as "America" and "Star Spangled Banner" brought the guests to their feet a number of times. Comedians and songsters followed in rapid succession. Tait's entertainers furnished by the courtesy

of the Tait-Zinkand Cafe, made the hit of the evening in their "Song to Lillibridge and Others," which is as follows:

National Electric Light Association you for me
To you I give a toast,
And it goes without saying
You're more than welcome to the Pacific Coast.
There's Mr. Elliott of New York,
To his right Mr. Hodskinson of Boston does sit,
But if you asked Brown of Chicago
To do you a favor
He'd say, "Let George do it."
So let us drink to Geo. Elliott
And of New York may he always boast,
And as Hod has BEAN to Boston
To him I give a toast

There's one more man I wish to mention
And Brown of Chicago I have in mind
And as all our friends leave San Francisco
May they build a Lilly bridge behind.
National Electric Light Association you for me,
To you I give a toast,
And it goes without saying,
You're more than welcome to the Pacific Coast
Now Sanford says Electricity is measured by Watts
And us he easily convinced.
But Dick still insists that it is measured by inches.

Now of Dayton I will sing and
I don't want anyone to laugh
For from old Ohio comes our beloved President Taft.
But take the letter "F" out of the word "Taft"
And you're more up-to-date,
Put an "I" in its place
And another great man we have
From Dayton who is Tait.

The evening closed resounding with the warm words of welcome of John A. Britton, representing the Electrical Development League of San Francisco, and the wholehearted response by F. M. Tait, vice-president of the N. E. L. A.

In detail, the entertainment of the evening was as follows:

Orchestra Selection	
Welcome by Chinese Flower Girls	
Young Arow Club	(Chinese Band Parade)
Newman & Decorsey	(Songs and Sayings)
Tait's Entertainers	(Courtesy Tait-Zinkand Cafe)
Norris Children	(Dutch Songs)
William O'Brien	(Tenor)
Alma Tuchler	(Recitations)
Dan Casey	(Songs and Jokes)
Lillian Byrnes	(Songs)
McKensey & Aguire	(Comedians)
Joe Eckstein	(Character Impersonations)
Address of Welcome	John A. Britton
Reply	F. M. Tait, Vice-President N. E. L. A.
San Francisco—Alex T. Vogelsang, Chairman Public Utilities Committee, San Francisco Board of Supervisors.	
Au Revoir	Geo. C. Holberton

On Friday morning the guests were taken to Mt. Tamalpais on the famous "Crookedest Road in the World." The Red Special left for the North with its guests at 7:20 in the evening. The days in California, so declare the visiting guests, will long remain a bright spot among memories, golden treasures.

TRADE NOTES.

Complete Allis-Chalmers electric motor equipment, for opening a sawmill at San Leandro, has been sold to the Hudson Lumber Company.

The Allis-Chalmers Company has sold the Standard American Dredging Company two steam turbines of 400 kw. and 500 kw., respectively.

The Pacific Gas & Electric Company is planning the construction of a new substation at Woodland to take care of the increased load in that developing territory, where there is great activity in electric railway projects.

The Dow Pump Company is making plans to erect a million-dollar plant in San Francisco for the manufacture of what is termed the improved Diesel engine. So great is the promised demand of this celebrated engine that the promoters of the plant here feel every assurance of the success of the proposed venture.

George J. Henry has just shipped a water wheel with a driver compressor to Angels for use in connection with the Sierra & San Francisco Power Company's dam on the Stanislaus River. The wheel is made heavy so as to act as a flywheel in driving an air compressor.. Contracts will soon be let for the construction of the new impounding dam.

Ashley & Kaufman, consulting engineers of New York, have opened permanent offices at 14 International Amphitheatre, Union Stock Yards, Chicago, Ill. Mr. John Fallon formerly of the Tennessee Copper Company will be resident engineer and in charge of the office. They have been retained as consulting engineers on the heating, lighting and sanitary engineer for the Union Stock Yards and Central Manufacturing District.

The General Electric Company has sold to C. C. Moore & Co., who have the general contract, two steam turbines, which will be installed in the power plant of the C. A. Smith Lumber and Manufacturing Company at Marshfield, Ore., mentioned in these columns last week. The usual accessories and switchboards are included. The generating units are described as follows: One A. T. B. 4, 2000 kw. (2500 k.v.a., .8 P.F.) 1800 r.p.m., 2300 v., horizontal condensing mixed-pressure Curtis steam turbine; one A. T. B. 2, 500 kw. (625 k.v.a .8 P.F.) 3600 r.p.m., 2300 v., horizontal, condensing, high-pressure Curtis steam turbine.

The General Electric Company has secured the contract for a great variety of electrical machinery for the Alaska Gastineau Mining Company. The largest item is a 1750 k.v.a. water-wheel type generator, 3-phase, 60-cycle, 2300 v., at 257 r.p.m., which is to be direct-connected to a water-wheel built by the Yuba Construction Company. Also, one A. T. B. 12, 1200 kw., 600 r.p.m., 3-phase, 60-cycle, 2300-v., belt-driven generator; one commutating pole, 45 kw., D.C.. generator; one 35 kw. motor generator set, consisting of one 550-volt commutating-pole generator, direct-connected to one 50-h.p., 2200-v., 3-phase induction motor; also a 75 kw. motor-generator set of same type; three 1250-k.v.a. transformers, for stepping from 22,000 to 2300 volts; some smaller transformers and complete switchboards for the above apparatus are also included.

INSULL BANQUET.

Samuel Insull of Chicago, who was recently made a director of the Pacific Gas and Electric Company, was the banquet guest of the district managers and heads of departments of that corporation at the Fairmont Hotel on Friday night.

John A. Britton, vice-president and general manager, presided, and introduced the guest to the ninety-five officials of the company with an interesting speech. In the course of his address, Mr. Insull referred to the Pacific Gas and Electric as one of the best-organized corporations in the West.

Stereopticon views were exhibited showing the power plants and other prominent features of the company's system. An elegant souvenir menu was issued with brief statistical information and local hits following each service of the banquet. The slogan was: "San Francisco knows how—with the help of Pacific Service—1915."

NEW APPLICATIONS FOR ELECTRICAL INSPECTOR.

New and improved specifications for rubber-covered wires and cords, as printed under Rule 50 in the 1911 edition of the National Electric Code, call for a product passing new electrical, physical and chemical tests designed to secure a better quality of insulation than previously prescribed.

Supplies of wire made according to the new specifications are now available, and the old label, printed on a yellow background, was discontinued January 1, 1912.

Wires shown by tests and examination conducted by Underwriters' Laboratories to be in accordance with the new specifications will have a label printed on a red background attached to each coil.

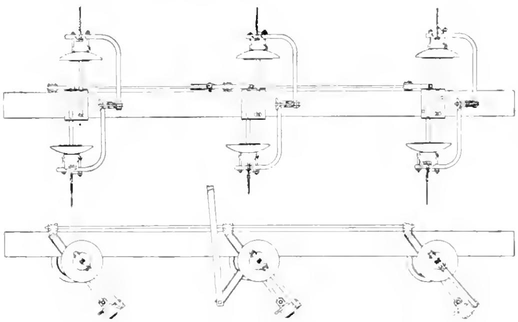
After July 1, 1912, the use of unlabeled wire or wire bearing the old discontinued yellow label will not be allowed.

WM. J. NIXON,
Chief, Department of Electricity, San Francisco, Cal.

INDUSTRIAL

K. P. F. DISCONNECTING POLE TOP SWITCH.

The illustrations herewith show the very latest type of high-tension disconnecting switches as manufactured by the K. P. F. Electric Company, 37 Stevenson street, San Francisco. Each 22,000 v. unit or pole is arranged to be supported on the standard single cross arm (6 x 6) in place of a regular line insulator. The strain of the line wire is carried through the switch itself, obviating the use of dead end insulators or double cross arm construction.



K. P. F. Disconnecting Pole Top Switch.

The switch consists simply of two suspension type strain insulators fitted with central pins and iron caps, one element fixed and the other rotatable about the axis of the pin.

The line wires are dead-ended onto the two caps, one of which supports an arm carrying a knife blade and the other a pair of jaws through which the circuit is made and broken.

A crank or lever fastened to the pin of the rotating insulator provides means for opening and closing the contacts.

As the supporting fixture is normally to be grounded the operating mechanism, arranged for single poles separately or three together, can be handled with safety.

The switch designed is for use on voltages of 6600, 11,000 or 22,000, when a single insulator is used, but can be operated on any commercial voltage by the addition of insulators in series.

ELECTROLYTIC LIGHTNING ARRESTER FOR RAILWAY SERVICE.

The protection of electrical apparatus from lightning and other high voltage static disturbances necessitates the use of a device that will relieve the abnormal pressure due to the static change and divert it from the susceptible windings of the machines into the ground.

It is not sufficient that the abnormal pressure be instantly relieved, but to prevent damage absolutely, the voltage at the machine should be prevented from rising abnormally. To accomplish this result the protective device must (1) begin to operate at pressures well within the breaking-down point of the insulation on the apparatus; (2) permit the enormous though very brief current of the static charge to pass instantly, as any delay in the passage of the charge causes a rise in pressure. A third requirement is that the protective device shall prevent a power current or arc from following in the path of the static discharge, as soon as the abnormal condition has been relieved. These conditions are particularly important in the protection of railway and other low voltage apparatus.

Lightning arresters of the spark-gap type possess the disadvantage, particularly for low-voltage work, that the voltage must rise to several times normal before the discharge occurs. Thus, with arresters having an equivalent spark gap as low as one-tenth of an inch, the voltage must rise to 4000 or more during discharge, while a comparatively high resistance in an arrester causes a choking effect on the static charge which tends to allow the voltage to become considerably high before full relief is afforded. These features account for the cases of lightning damage in spite of spark-gap type arrester.

The ideal lightning arrester for low-voltage circuits is the electrolytic type. This type of arrester has two essential characteristics, due to a film of hydroxide of aluminum, deposited on aluminum plates or trays, that enable it perfectly to fulfill the conditions required. These essential characteristics are: (1) that it automatically offers a very high resistance to currents at normal voltages and a very low resistance to currents above a certain critical voltage; and (2) that it posseses the properties of a condenser, offering high effective resistance to currents at low frequency, and low effective resistance to currents at the high frequencies that are prevalent in lightning discharges.

The decrease in resistance occurs very rapidly at a certain critical voltage, so that for currents at double the normal voltage, the film offers practically no resistance to the flow of current, but when the excessive voltage ceases, the resistance is instantly restored and no power current follows the discharge nor is there any arcing.

A design of an electrolytic arrester for railway work has recently been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., built in two styles, for 600 and 1500 volt circuits.

The arrester consists of a tank of oil in which are placed, on properly insulated supports, a nest of cup-shaped aluminum trays. The spaces between the trays are filled with electrolyte, a sufficient quantity for one charge being furnished with each arrester. The top tray is connected with the line through a 60-ampere fuse, and the bottom tray is connected to the tank which is thoroughly grounded by means of a lug. A fuse of the enclosed type is mounted on the cover of the arrester.

A small charging current flows through the trays continuously and keeps the films on the trays built up, so that no charging is required. This charging current is not, however, of sufficient value to raise the temperature appreciably.

The effectiveness of a lightning arrester is largely affected as explained above, by the resistance it offers to the discharge, and in an electrolytic arrester this depends on the area of the aluminum plates. It should, therefore, be borne in mind that the degree of protection is largely dependent on the aluminum plate area, while the integrity of the arrester under hard service and varying line voltage demands large thermal capacity and radiating surface in order to prevent any temperature rise.

The Westinghouse type A arrester is built with ample immersed plate or tray surface, using the same trays employed in the high voltage alternating-current arresters. The immersed area of each tray is 100 square inches, which is over twice as large as that in any other direct-current arrester of this type. The shape and the arrangement of the trays is such that any gases generated by the discharge can pass out readily without disturbing the electrolyte between the trays. The volume of oil and cooling surface are also correspondingly large, rendering this type a large substantial arrester for connecting to bus-bars in direct current plants and giving thorough protection to power apparatus and meters.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—Los Angeles Dry Battery Company; capital stock $25,000; subscribed $500. Directors Fritz Heine, Carl Jaeger, Elmer E. Morgan, Albert Erickson, Carl Pressel.

ILLUMINATION.

LEWISTON, IDAHO.—The Pacific Power & Light Company will rebuild its gas plant in East Lewiston at a cost of $50,000. The company recently extended their system to Lewiston and Clarkston, making a larger plant necessary.

ASTORIA, ORE.—The Elk Creek Light & Water Company has been organized by Orrin Kellogg, O. J. Kraemer and Lester W. Humphreys, with capitalization of $5000, to construct and operate a water system and power plant at Elk Creek.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has asked the city permission to bring its high power line from Sumas through the city streets, in order to be in position to furnish power to the Skagit County interurban line.

EUGENE, ORE.—The Oregon Power Company has started preliminary plans for the development of 12,000 to 14,000 h.p. on the MacKenzie River at Martin's Rapids. Probably $1,000,000 will be expended in the work. This company succeeds to the rights and property acquired by the Northwestern Corporation.

TRANSMISSION.

SANTA BARBARA, CAL.—The Coalinga Water & Electric Company has asked for a blanket franchise for the use of the public roads in Santa Barbara County for the distribution of electric power.

EUGENE, ORE.—Plans for the development of 12,000 to 14,000 horsepower at Martin's Rapids on the McKenzie River 33 miles east of Eugene, are being made by the Oregon Power Company. Probably a million dollars will be required to develop the project.

SAN FRANCISCO, CAL.—The San Joaquin Light & Power Company has filed an application with the State Railroad Commission for a certificate of public convenience and necessity to enable it to enlarge its distributing facilities. The company proposes to construct an additional transmission line for the purpose of augmenting its supply in the oil districts of Coalinga, Midway, Lost Hills, McKittrick and the Kern River fields. The corporation states that there is an increasing demand in these sections for power and that it desires to meet it. It is stated also that the new lines would enable the company to sell power to agricultural districts which are now without the service.

TRANSPORTATION.

POMONA, CAL.—The first work of electricizing the Covina branch of the Southern Pacific commenced June 1.

SAN JOSE, CAL.—The San Jose Terminal Railway has been granted a franchise to operate an electric railroad on Second street.

RIALTO, CAL.—Citizens will raise $25,000 for purchasing the right-of-way for a new electric line which the Pacific Electric will build from Upland to San Bernardino.

STOCKTON, CAL.—The State Railroad Commissioners have granted the Stockton Terminal & Eastern Railway permission to issue $65,000 bonds. The road is incorporated to run from Stockton to the town of Jenny Lind in Calaveras County, a distance of 30 miles. The line has been constructed and is in operation from Stockton as far as Fine, a distance of 15 miles, over which trains have been running since September, 1910. Steam service has been succeeded by gasoline motor cars, and the company plans ultimately to operate by electricity. The proceeds of the bond sale are to be devoted to the discharge of obligations to the amount of $26,925.32, and for extensions and improvements. The Commission issued a statement in granting the permission, in which it goes on record as warning the investing public that the commission guarantees on bonds, stocks or other securities which it authorizes.

TELEPHONE AND TELEGRAPH.

EL PASO, TEXAS.—Improvements to be made by the Mountain States Telephone & Telegraph Company in Downey, Arizona, will involve an expenditure of $35,000.

ASTORIA, ORE.—Secretary Bennett of the Clatsop Cranberry Company has arranged with the local telephone company to install a complete metallic service between Astoria and Clatsop which will serve the residents in the immediate neighborhood of the cranberry marshes.

SAN FRANCISCO, CAL.—At the request of the Supervisors' telephone rate committee, P. H. Coolidge, general commercial superintendent of the Pacific Telephone Company, has filed a statement of the gross toll business between this city and Oakland. Calls originating in San Francisco exceed those from Oakland in terms of revenue by $22,262.32. The toll business from this city to Oakland in 1911 was $135,855.77, and from Oakland to this city $113,593.45. At a recent rate hearing the telephone company was accused of failing to give San Francisco credit for the large outgoing toll business.

PHOENIX, ARIZ.—Application for a receiver for the Overland Telephone & Telegraph Company has been filed in the Superior Court by the Pacific States Electrical Company of San Francisco. According to the plaintiff, the assets of the Overland are about $435,000. Its liabilities are not totaled, though a long list thereof is given. Counting $500,000 worth of bonds, the debts of the corporation are over $700,000. The Overland's assets consist of a complete system in Phoenix, Tempe, Mesa and Jerome, with smaller systems in several other northern Arizona towns; also several hundred miles of toll lines.

WATERWORKS.

LOS ANGELES, CAL.—San Pedro Water Company has offered to sell to the city its plant at San Pedro.

PASADENA, CAL.—The City Council has passed a resolution for municipal water works, the estimated cost to be $1,250,000.

TACOMA, WASH.—The county commissioners have granted a 25-year franchise to the Crystal Springs Water & Land Company to lay a pipe line around Lake Steilacoom, for the purpose of furnishing drinking water to residents of that section.

SALMON, IDAHO.—The contract for the construction of extensions and improvements of the Salmon City water plant, now the property of the city, has been awarded to the Vogler Plumbing & Heating Company of this city for the entire work on its bid of $24,250.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII SAN FRANCISCO, JUNE 22, 1912 NUMBER 25

PHOTOGRAPHY IN ENGINEERING WORK

BY M. R. LOTT.

The art of photography has within the last few years assumed an important part in an engineer's work, its value lying in the conveniences offered around the office as well as the means which it furnishes for a correct representation of matters in the field.

4. To illustrate reports on tests.
5. To show drawings in a reduced size.

The first four uses named deal with photography outside the office and for this work an Eastman 3-A kodak or a 5x7 Century camera will be found satisfactory. The 3-A kodak is particularly adapted for ordinary purposes, for rough country trips, or times when it is essential to carry a light equipment. By its use satisfactory results may be obtained and the size of picture secured (3¼ in. x 5½ in.) is usually sufficient. When a larger sized picture is required and weight is not an inconvenience, the 5x7 Century camera using glass plates can be advantageously used, as the plates yield better negatives than film packs.

A Striking Illustration of the Incorrect and Correct Process of Photographic Printing.

A brief statement of the ways in which an engineer may advantageously use photography is made as follows:

1. To illustrate a report on the preliminary investigations of a new project.
2. To form a record of the progress made on construction work.
3. To give a true representation of completed structures.

The photographs, reproduction of tracings and drawings is one of the greatest conveniences to the engineer, for it enables him to have a number of working drawings in a compact space yet of a size sufficient to have all the characters distinctly legible, provided the drawings and tracings are prepared in a proper manner. For the reproduction of a working drawing the best results can be obtained by photographing the tracing of the drawing using transmitted light, though good results can be obtained by photographing the drawing itself, using reflected light. The secret of properly preparing the drawing lies in the use of plenty of ink, making the lines and characters heavy, more so than an ordinary person would consider necessary.

The photographing of drawings and the handling of the work done in the field comes under office supervision and it is the purpose of this article to describe the arrangement, equipment and methods adaptable for carrying out this line of work in a convenient and efficient manner and according to ways tried and proved to be satisfactory in a large engineering office.

Details of Arrangement and Equipment.

Three rooms are essential for carrying on the work, a studio and two dark rooms, one for developing and one for printing and enlarging, the arrangement shown in Fig. 1 being a convenient one. The studio and the printing room should be on the north side of the building, unobstructed as to view, the light coming in through a north window, for with this location the intensity is more even than that which comes from any other direction. In the arrangement, as shown, all three rooms should be readily accessible to each other, the developing room being separate from the printing room, thereby enabling two people to carry on these operations at the same time without interference. The little ante-room separating the two dark rooms and opening into the studio greatly improves the light proof qualities of the two dark rooms.

Ventilation is necessary and to secure this, a small ventilating fan may be used with good results, the air being drawn from the upper portion of the rooms, passages being provided for the incoming air through the window of the printing room and at the bottom of the doors by boring holes through the wooden frame-work. These holes should be covered with galvanized iron hoods, painted a dull black, and so placed that they clear the floor by about half an inch. The hoods afford protection from the light which might tend to come in.

The Studio.

In Fig. 1 the main dimensions of the studio are given as being 15 ft. x 20 ft., which size is sufficient to carry on the work to be done in this room. A closet for storing supplies is a feature not to be overlooked.

A large window 6 ft. wide by 4 ft. 6 in. high on the north side of the room provides illumination. It is arranged to accommodate the tracings to be photographed. For this purpose, the light coming through should be diffused, diffusion being accomplished by the use of the transparent tracing cloth, Excelsior brand being found satisfactory. The tracing cloth is tightly stretched and fastened to a wooden frame fitting snugly into the frame work of the window. A convenient way for holding tracings while they are being photographed is to use clips held by coiled

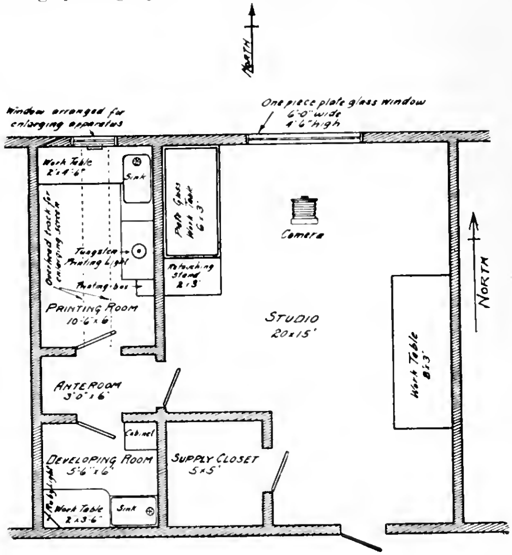


Fig. 1. Plan of Studio and Dark Rooms.

springs and small brass chains which fasten to hooks arranged at intervals on the frame work. This arrangement permits of easy adjustment and holds the tracing smoothly and securely.

When photographs of drawings are to be taken by reflected light, a skylight greatly aids the illumination, but if one is not available, good results may be obtained by fastening the drawing with thumb tacks to a screen made of "Compo-board." The screen should be mounted on a frame work capable of being easily moved around the room. Illumination of the drawing may be helped out by means of lamps arranged similarly to those used in lighting display windows, the light being thrown upon the drawing and at the same time concealed from the camera.

The walls of the studio should be finished in white to improve the general illumination.

The camera used may be of the studio type and should be provided with a lens suitable for copying work. A "Goerz Dagor" F:7.7 Focus 14 in. has been found to give excellent results. For easy manipulation the camera should be mounted on a studio stand.

The studio should be equipped with two work tables about 8 ft. x 3 ft. in size, and it will be found convenient to have one of these provided with a plate glass top. A retouching stand may be placed at the south end of the table with the plate glass top. An idea for the construction of a retouching stand may be gained from Fig. 2. It consists of a plate glass working surface mounted at an angle of 45 degrees with the horizontal, behind which an incandescent lamp is arranged to furnish the desired illumination. The plate glass should be backed with a tracing cloth for diffusing the light and should it be desired to limit the size of working space, that portion of the plate

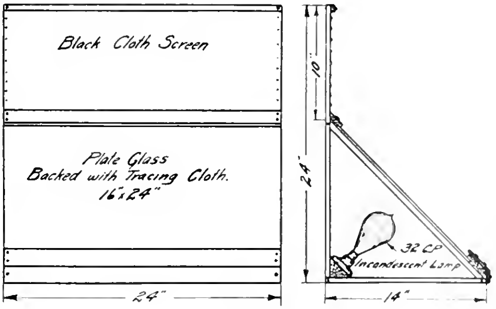


Fig. 2. Retouching Stand.

glass working surface to be without illumination may be blocked off by pasting black paper to the back of the glass. A black cloth screen extending above the working surface shuts off the undesirable light coming from the north window.

A BAD LAW THAT SHOULD BE CHANGED.

In the issue of the Journal of February 3, 1912, on page 97, there was published in full the details of Chapter 499 of the Statutes of California for 1911. This enactment was approved April 22, 1911, and is an act regulating the placing, erection, use, and maintenance of electric poles, wires, cables and appliances, and providing the punishment for the violation thereof.

No law, in recent years, has been so inconsistent and impossible of clear interpretation as this law appears upon careful study and an attempt to apply to given cases.

Anyone having suggestions for bettering this law is urged to send them to the editorial staff of the Journal of Electricity, Power and Gas.

In a discussion at the Los Angeles Section of the A. I. E. E. on May 21, 1912, J. E. Macdonald's paper brought up the question of the proper application of the new state law, No. 499, as applied to joint pole construction, in the State of California. From a careful study of this law, it appears that the specifications were drawn up to cover one company only, and afterwards a modifying clause was put in to provide for joint pole construction. This modifying clause is both conflicting and ambiguous, and has probably caused more trouble and different interpretation of the law, than the entire remaining part.

Section "C" first provides for a clearance of four feet between low voltage wires and high voltage wires. It does not limit the number of arms, the distance the arms are apart, or the number of companies on the poles; it simply provides that low voltage wires must be at least four feet from the high voltage wires.

Section "C" further provides, where two or more companies for the distribution of electric light and power, occupy the same poles with wires or cables, the high voltage wires shall all be on one side of the poles, and the low voltage wires on the other side; with no less than thirty-six inch clearance in a horizontal line, and further provides that in such construction, all cross-arms shall be at least thirty-six inches apart in a vertical line. Now here comes the sticker:

1. With two distributing companies on one pole, if we keep our low voltage wires four feet from the high voltage wires, is it necessary to keep the high voltage wires on one side of the pole only?

2. With high voltage wires four feet from the high voltage wires, can we place our arms, which have only high voltage wires on them, two feet apart, just so the low voltage wire is put on the arm which is four feet from the high voltage wires? In other words, in combination work, if we keep our high voltage wires four feet from our low voltage wires, as provided for in the first part of clause "C," cannot we build and maintain our combination lines with the same construction as provided for in the first part of clause "C"? Does the thirty-six inch provision, and the provision for high voltage wires to be on one side of a pole, only apply when arms are put on the pole less than four feet apart?

3. What is meant by a distributing company in this clause "C"? Would a lighting company's high line, or a railway company's high line be classed as a distributing line on a combination pole, if the company who owns the high line had no other wires, than the high line wires on the pole? Take for instance where one distributing company has a high line on top of a line of combination poles, and a second distributing company makes combination on those poles, would it be necessary for this second company to place all their high voltage wires on one side of the poles, and all their low voltage wires on the other side of the poles? If that is the case, would not the distributing company who owns the high line be compelled to place their entire high line on one side of the poles also?

There are several other points, such as providing some way to buck arm with low voltage wires from a pole, other than compelling the buck arm to be four feet below the line arm, which carries the high voltage wires, for by this provision it throws the line cross-arms eight feet apart on our corners, and it is getting to be necessary to plant one-hundred foot poles to make some of our corners.

The above questions are only a few of the complications which the companies have been compelled to meet, and each company is deciding these questions in a different manner, and it is recommended that some concerted action be taken by the various companies, so that recommendations can be made to the proper authority before the next legislative meeting, to have the objectionable clauses corrected and the law amended, so that it will answer the purposes for which it is intended; that is, to require better and safer construction work over the entire state.

SHIPS TO CARRY WIRELESS.

R. Y. Cadmus, United States Inspector of ship wireless telegraphy for the Pacific Coast, with headquarters in San Francisco, received notification from the Department of Commerce and Labor that on and after October 1, 1912, all vessels carrying 100 persons, including the crew, must have two wireless operators and wireless apparatus with a radius of at least 100 miles. The inspector also was notified that after January 1, 1913, all ships carrying passengers must be equipped with wireless apparatus and day and night operators.

The Delegates to the Seattle Convention Aboard

AFTER FLASHES OF THE SEATTLE CONVENTION OF THE N. E. L. A.

The electrical Hegira from all parts of the United States to the Seattle convention of the N. E. L. A. presented an interesting spectacle. Six special trains and several special cars traversed the continent, or considerable portions of it, bringing visitors from Boston, New York, Philadelphia, Pittsburg, Chicago St. Louis, Mobile, Denver, Los Angeles, San Francisco and many other cities. All of these trains were finely equipped, and one especially elaborate tour-de-luxe was arranged, enabling those who participated to make a long, circular journey throughout the West, including a visit to the Grand Canyon and California. No less surprising in its brilliancy of detail was the Golden Poppy Special from California, which was planned in minutest detail for the comfort and pleasure of its passengers, by the Electrical Development League of San Francisco. The sight of a ten-car special trailing its luxurious course over the celebrated Shasta Route laden with electrical men from California is interesting and at the same time unique. Much credit is due the Southern Pacific Company and the Pullman Car Company for their efforts in getting together an undertaking hitherto unattempted in the West, and at the same time putting through this undertaking on schedule time.

A photograph of the party comprising the Golden Poppy Special, taken by the Wagner Electric Manufacturing Company, as a feature of their entertainment, is shown above. This photograph will be supplied to members of the Golden Poppy Special, with compliments of the Wagner Electric Manufacturing Company.

Truly Western style characterized the frolic enjoyed by all on board throughout the entire journey to Seattle. The train was elaborately decorated with golden poppies bearing the magic insignia "San Francisco, 1915." In the observation car was to be found a Victrolia and a full grown piano which was kept busy throughout the journey. A mock negro wedding proved of unusual originality and afforded keen pleasure to all.

On Monday evening preceding the convention, an elaborate ball was given in the Armory to all visiting delegates and their ladies by the Seattle electric power interests. The hall was beautifully and artistically decorated and the chic gowns of the visiting ladies made it resplendent and in full keeping with the magnitude of the art represented, for it is said that the membership of the N. E. L. A. comprises $2,500,000,000 in invested capital.

While the attendance at the convention was not as large as at some recent conventions, it was not expected that it would be, owing to the geographical location of Seattle to the center of population of the association membership. "Picked men" journeying from long distances, however, constituted a quality of attendance never before realized in the proceedings of this organization.

The program included over seventy addresses, papers and reports and covered a wide range of topics of increasing importance to the industry. Fifteen hundred keen observers commingling from every electrical center of the country not only gave these men an idea of the extent of the conception of the electrical development in the Rocky Mountain and Pacific Coast states but it has also facilitated first hand observation of a type of sturdy and alert Americanism that has its lessons for residents of the eastern and central sections of the country. Indeed, sectional intercourse of this sort paralleling and synchronizing currents in national hydroelectric life and central station practice is highly advantageous.

the Golden Poppy Special at Shasta Springs.

Trip to Snoqualmie Falls by Delegates.

Despite the threatening weather, about 480 persons were on hand Friday, June 14, for the special trip to the Snoqualmie Falls and White River developments through the courtesy of the Puget Sound Traction, Light & Power Company.

The special left at 8:30 and after three hours' traveling through the picturesque Lake Washington region, arrived at the Falls. About an hour was spent inspecting this unusual installation and viewing the inspiring falls, practically all of the visitors crossing the suspended foot-bridge and climbing the point to obtain the fine view of the latter. It was not possible to visit the "Cavity Station" in the valley 300 feet below, on account of the large crowd and small capacity of the elevator. A box lunch was served on the train, followed by refreshments of all kinds throughout the afternoon. About twenty miles from the Falls an accident to one of the engines delayed the train for a considerable time, so that on account of the lateness in reaching Seattle about half of the delegates decided to abandon the trip to White River and returned direct to Seattle. The other half proceeded to the White River plant, arriving about 5 o'clock. After reviewing this most interesting installation the party returned to Seattle, everyone voting it a most enjoyable and profitable day. The visiting delegates wish to extend their thanks to the Puget Sound Traction, Light & Power Company for the delightful trip and for their thoughtfulness and courtesy throughout.

Portland's Hospitality.

Portland was not asleep to the call of western hospitality and the returning delegates on Saturday, June 15, found three delightful trips planned, which were consummated with joy to the visitor and much credit to Portland talent. Trip No. 1 included a trip to the Cazadero River Mill hydroelectric plant. Trip No. 2 comprised a 30-mile trip up the Willamette River by boat or rail with a stop-over at Oregon city. Trip No. 3 was completed in seeing Porland—the Rose City—by special observation cars. In the evening the electrical parade of the Rose Festival was enjoyed from special grandstand accommodations, which controlled an excellent view of the festivities.

N. E. L .A. CONVENTION EXHIBITS AT SEATTLE.

In connection with the 35th annual convention of the National Electric Light Association at Seattle, June 10-14, 1912, a number of interesting exhibits were made by the manufacturers.

American District Steam Company displayed samples of fittings for district steam heating and distributed descriptive literature. E. L. Barnes was in charge.

Benjamin Electric Manufacturing Company showed a full line of Benjamin lighting specialties including sockets and shades. These were ably demonstrated by W. D. Steel, F. H. Poss and M. F. Steel.

Century Electric Company exhibited a full line of Century single phase motors and illustrated several of the wide number of domestic and industrial uses to which they are applied. R. J. Russell, H. H. Thedinger and S. B. Smith were in attendance.

Commercial Section N. E. L. A. distributed literature on the application of electricity, P. S. Dodd being in charge.

Copeman Electric Stove Company demonstrated automatic cook stoves. L. W. Copeman and K. W. Dawson were present.

Dalton Adding Machine Company showed a representative line of adding machines.

Dearborn Drug & Chemical Works occupied attractive quarters where they distributed literature on treating boiler feed water, lubricating oils and greases. E. C. Brown, J. W. Harkins and J. B. Lincoln were the representatives.

Electric Storage Battery Company occupied two booths with a comprehensive exhibit of storage batteries for ignition,

and electric vehicle service. Attractive literature on large battery plants was also distributed. Those in attendance at the convention from this company included G. H. Atkin, J. Gay, G. R. Murphy, W. G. Bardens, H. S. March, J. W. Conley.

Electrical Review and Western Electrician of Chicago was represented by A. A. Gray and F. R. Schalck.

Electrical World of New York City published the Convention Daily and had ten representatives in attendance.

Eureka Vacuum Cleaner Company demonstrated their product.

Federal Sign System (electric) had an attractive exhibit of electric signs and demonstrated several household specialties, including their power table, vacuum cleaner and "Dim-a-Lite." J. H. Goekst and J. M. Gilchrist were in this booth.

Fort Wayne Electric Works of General Electric Company had a representative exhibit of small motors, fans, transformers and meters, also illustrating the application of Fort Wayne motors to a refrigerating machine. A special feature was the initial exhibit of the Audiffren-Sungrun refrigerating machine. F. S. Hunting, G. I. Kinney, W. R. Hendrey and H. L. Eicher were present.

Franklin Electrical Manufacturing Company displayed Franklin incandescent lamps. P. W. Huston and R. D. Holabird represented the company.

General Electric Company occupied six spaces with an instructive exhibit of apparatus in actual operation. This included an induction regulator, color matching outfit, and typical G. E. motors, among them being a 25 h.p. mining type motor. The lamp exhibit included a full showing of Mazda lamps, an intensified arc for a.c. circuits, a long life flame arc and several luminous arcs. Various standard heating and cooking devices were displayed, the radiant grill and domestic range commanding especial attention. A 1 kw. combination gasoline engine and generator was another of the interesting features. An indicating steam flow meter was also shown. Those in attendance were R. J. Lovejoy, C. W. Stone, Dr. Thos. Addison, J. A. Cranston, T. E. Bibbins, R. J. Cash, Theo. Beran, R. E. Moore, H. L. Monroe, G. D. Rosenthal, C. E. Burleigh, C. H. Alexander, A. K. Baylor, F. G. Vaughen, M. O. Troy, N. R. Birge, D. B. Rushmore, E. E. Gilbert, Frank H. Gale, A. D. Page, G. C. Osborn, R. B. Parker, F. M. Sanford, John Howell, W. R. Burrows, C. M. Bliven, Frank Stone, C. R. Wallis, J. W. Van Huysen, A. S. Heyward, A. G. Jones, A. S. Moody, H. E. Duren, E. F. Whitney, H. Oliver, I. A. Shorno, H. A. Boring, E. C. Fellows, and A. D. Pritchard.

G. & W. Electric Specialty Company showed pot heads and junction boxes, being represented by G. P. Edmonds and R. L. Phelps.

Hubbard & Company displayed a large line of pole line equipment and tools. R. N. Dickinson and A. E. Boyles were there.

Hughes Electric Heating Company demonstrated electric cook stoves.

Hurley Machine Company showed the operation of their washing machine, N. Hurley being in charge.

H. W. Johns-Manville Company occupied three spaces with an elaborate display of fuses, boxes, insulating and construction materials, as well as fibre conduit and fittings. A special feature was the initial exhibit of the Audiffren-Singrun refrigerating machine. Linolite lamps and Frink reflectors were attractively shown as was also a complete line of asbestos products. Those in charge were J. W. Perry, R. C. Cole, S. P. Russell, G. A. Saylor, F. W. Loomis, G. G. Gunderson and S. F. Mills.

Meter Exhibit N. E. L. A displayed a comprehensive line of meters and meter accessories.

Metropolitan Engineering Company showed electric protective devices.

Minerallac Electric Company displayed electric meters and insulating materials. H. S. Sines and C. N. Arnold were there.

National Electric Lamp Association occupied four central spaces with a brilliant showing of many styles and types of incandescent lamps. These were attractively displayed to great advantage by various novel arrangements. Representatives in attendance included J. Robert Crouse, H. A. Tremaine, S. E. Doane, W. M. Skiff, W. Harrison, L. S. Twomey, R. Beman, R. E. Campbell, J. A. Vandergrift, H. Eisenmenger and E. H. Haughton.

Otis Electric Company distributed literature on elevators.

Pacific Electric Heating Company occupied two spaces with an attractive display of electric household heating devices. F. Booth, H. T. Van Riper, J. N. Bowden and H. T. McCrea were in attendance.

Philadelphia Electrical Manufacturing Company exhibited lighting devices, C. L. Bundy being in charge.

Portland Railway, Light & Power Company distributed thousands of roses.

Simplex Electric Heating Company demonstrated a great variety of electric heating devices. These included electric ranges, hot closets, buffet servers, plate warmers, chafing dishes, percolators, tea sets, toasters, griddles, broilers, waffle irons, milk warmers. Electric radiators, circulation water heaters, foot warmers, heating pads, curling irons and laundry irons were also exhibited. Special attention was called to the "enamel method" in the heating elements and the "lock on" arrangement. The exhibit was in charge of J. S. Ayer, assisted by Garnett Young, F. G. Larkin and F. H. Smith.

Wagner Electric Manufacturing Company demonstrated their unity power factor motor, switchboard instruments and alternating current rectifiers in two central spaces. F. N. Jewett, J. Mustard, A. J. Myers, T. S. Clark, F. R. Bates and Ray D. Lillibridge were in attendance.

Waverley Company, represented by F. T. Bird, showed an electric automobile.

Western Electric Company made a comprehensive display of fans, telephones, vacuum cleaners and electric household appliances. F. B. Gleason, P. J. Aaron, Carl Bush, M. H. Nichols, F. Parish and A. L. Philips were in charge.

Weston Electrical Instrument Company gave a graphical demonstration of their switchboard ammeters, voltmeters, frequency meters, power factor meters and synchroscope. They also displayed a large number of portable and precision meters. F. E. Smith and A. Honeychurch were in charge.

Westinghouse Company occupied six spaces. Those in charge were: G. E. Tripp, L. A. Osborne, S. L. Nicholson, W. W. Briggs, C. S. Cook, G. B. Griffin, J. C. McQuiston, A. A. Brown, W. S. Rugg, J. J. Gibson, W. E. Brett, T. P. Gaylord, C. E. Heise, K. E. Van Kuran, A. Tobias, J. W. Busch, Geo. W. Ewing, Stephen Gardiner, S. I. Hayes, A. M. Irwin, W. D. McDermott, B. C. Mannell, T. J. Pace, E. A. Thornwell, L. L. Warfield, P. N. Kellock, and Messrs. Sailor, Milton, Robeshitte, Lamont and Whaling.

A complete line of carbon and oil circuit-breakers, switchboard and portable indicating meters, watthour meters, arc lamps and headlights, transformers, oil treating outfits, regulators, rectifiers, lightning arresters, insulating material, small motors, a complete line of fans and heating devices.

A switchboard has mounted thereon a complete line of the Westinghouse indicating meters with seven-inch dials, showing in a very convincing manner the saving in switchboard space to be gained by their use. These meters are connected to live circuits and thus are shown in actual operation, one being in series with a "skedoodle" plug, illustrating its dead beat qualities.

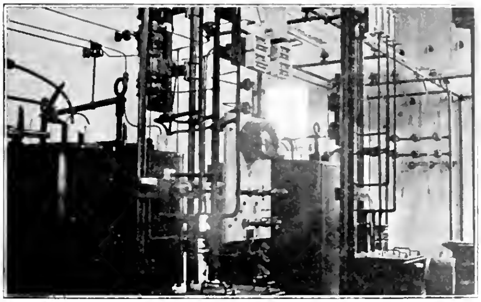
A complete line of modified types of carbon circuit-breakers of the laminated stud type for use on either a.c. or d.c. circuits were shown.

WESTERN STATES GAS AND ELECTRIC COMPANY'S RICHMOND HOLDINGS.

In the issue of this Journal of April 27th a detailed account of the Stockton plant of the Western States Gas and Electric Company was given. At the same time that the Stockton holdings were taken over by the Western States Gas and Electric Company, which was, as has been stated, in November of 1910, the Richmond Light and Power Company was also absorbed by this same corporation.

Exterior View of Distributing Station.

In 1902, Point Richmond, then only a sparsely settled rural district, saw the beginning of what came to be known as the Richmond Light and Power Company. The original installation consisted of a 100 kw. generator driven by double expansion reciprocating engine. In 1908, three 100 kw. transformers, stepping down from 11,000 to 2400, were added in order to assist peak load conditions by purchasing power from



Rear View Interior of Richmond Substation.

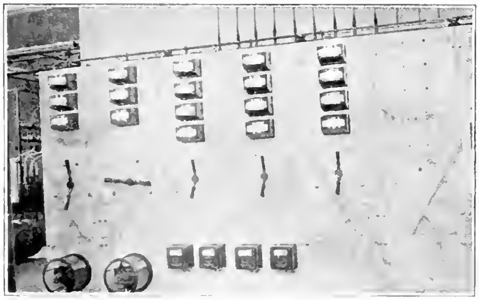
the Pacific Gas and Electric Company. During this brief period Richmond had grown from a settlement of but a few hundred people to a rising young city of 10,000.

To-day, however, the entire local generation of power has been done away with and all the electrical energy required is purchased from the lines of the Pacific Gas and Electric Company. A thoroughly modern reinforced concrete building, 46:6 ft. by 39:6 ft., has been erected to house the main substation equipment. This building is located on the corner of in Richmond.

Here are to be found three 100 kw., 10,000-2400-volt oil-insulated, air-cooled General Electric transformers and also three 200 kw., 10,000-2400-volt, oil-insulated, air-cooled Allis-Chalmers transformers. Hartman switches are used throughout on all distributing circuits as well as on the main feeder circuit.

Three mercury arc rectifiers of the General Electric type, 60 cycles, with a primary voltage of 2200 and rectifying voltage of 4500, provide constant direct current to the extent of four amperes. This current is used to supply 115 General Electric Series Luminous magnetite arcs, although the rectifiers are sufficient in capacity for 150 arcs of similar make.

The company is now using an automatically controlled feeder regulator, induction type, 60 cycle, with primary amperage of 2450 and secondary amperage of 150 G. E. Type I. R. T.



Switchboard Front.

Horn lightning arresters are used with surge dischargers of the General Electric type set for 6.6 amperes maximum and 4500 volts. The 11,000 volt distribution circuit owned by the Western States Gas and Electric Company comprises six miles known as the "County Road," three miles as the "San Pablo," two miles as the "Los Angeles Press Brick," and three and one-half miles as the "Point Orient" line.

The offices of the company are housed in the Neill

Office at Richmond.

Building in comfortable quarters. This building is located in the heart of the rapidly growing business district of Richmond.

BATTERY CAR TRAVELS FAR.

With a capacity of carrying 30 people at 30 miles an hour and running 360 miles without a recharge, the first Edison electric storage battery railroad car to be used west of the Rocky Mountains has arrived in Seattle and will go to Alaska on the steamship Edith. The new car will be placed in operation on the Tanana mines railroad between Fairbanks and Chatanika. It cost $38,000 at New York and was purchased by Falcon R. Joslin, president of the road that will use it, to eliminate the heavy cost of fuel in Alaska. Many similar cars are in operation in Europe, Japan and New Zealand.

WESTERN LAWS OF ELECTRICITY AND WATER

RIGHTS OF WAY OVER PUBLIC LANDS.

For Ditches and Reservoirs.

BY A. E. CHANDLER.

As stated in the first article of this series the first congressional legislation regarding rights of way over the public domain was the Act of 1866, now Section 2339 of the Revised Statutes of the United States. It acknowledges and confirms rights of way for ditches used in connection with "vested and accrued" water rights for "mining, agricultural, manufacturing, or other purposes." It is still in force for all unreserved public lands for purposes other than the generation of power.

By virtue of the provisions of the Act of 1866, one may go upon the public domain, dig his ditch, divert and apply water to beneficial use, and thus secure right of way over the land occupied. As the act recognizes only rights of way for ditches used in connection with vested water rights, it would seem that no right of way would attach until the completion of the works so that the water could be diverted. The California Court of Appeals has held otherwise, however, in de Wolfskill v. Smith (89 Pac. 1001.) The plaintiff had posted notices of water appropriation at abandoned oil wells, on unoccupied public land, from which water was flowing. She proceeded with her ditch construction with due diligence until enjoined by the defendant Smith who had made homestead entry on the land soon after the notices were posted. Although the court points out that the posting of a notice "does not constitute an appropriation" and that the "right to water depends upon * * * making an actual appropriation of its use," it holds.

> By posting the notice appellant (plaintiff) from that time became vested with the right to the use of the stream of water then flowing from these wells, together with the right to construct over and across the land the necessary ditches to divert and conduct the same to the place of intended use.

It is certain that as against the government the water right is not considered vested until the diversion works are completed and ready for use. Under the provisions of the Reclamation Act the public lands within a reservoir site, known as Alkali Lake, in Antelope Valley, California, were withdrawn from entry. The Rickey Land and Cattle Company owned all the private land within the site and also irrigation ditches running from the West Walker River to the site, which it intended to use for storage purposes. It applied for right of way over the public land within the reservoir site under the Act of 1891, and, after the rejection of its application by the Secretary of the Interior, it proceeded with the construction of a tunnel outlet, claiming that its rights were vested under the Act of 1866. The government, in the interest of the Reclamation Service, thereupon instituted suit and the company was enjoined from prosecuting the construction work. (U. S. v. Rickey Land & Cattle Company, 164 Fed. 496.) In this case it was impossible to use the reservoir before the completion of an outlet tunnel and channel for the return of the stored waters to the West Walker River. After quoting Sections 2339 and 2340 of the Revised Statutes the court says:

> It is very clear that no one can under these sections acquire as against the government, a vested easement in and to public lands, for a reservoir site, until the actual completion of the reservoir, so that the waters to be impounded therein may be applied to the beneficial uses, contemplated by the irrigation system of which it forms a part.
>
> This was the construction placed upon these sections by the Supreme Court, in Bear Lake Irrigation Company vs. Garland, 164 U. S., pages 1, 18 and 19, in which case it was said:
>
> It is the doing of the work, the completion of the well, or the digging of the ditch, within a reasonable time from the taking of possession, that gives the right to use the water in the well or the right of way for the ditches or the canal upon or through the public land. Until the completion of this work, or, in other words, until the performance of the condition upon which the right to forever maintain posession is based, the person taking possession has no title, legal or equitable, as against the government.

Regardless, therefore, of the doubtful logic of the de Wolfskill case, no one planning any material diversion work should rest upon the Act of 1866, but should secure his right of way or permission to occupy public lands before initiating actual work.

Act of March 3, 1891: The Act of March 3, 1891, grants rights of way over public lands and reservations for irrigation ditches and reservoirs upon the approval of applications by the Secretary of the Interior. Such applications must be filed with the register of the land district in which the ditch or reservoir is to be located. The required contents of papers and maps forming the application are specified in detail in the regulations of the General Land Office, and the applicant must follow the directions to the letter. (Copies of the regulations will be sent on request to the General Land Office, Washington, D. C.) The right of way granted extends, where necessary for construction on maintainance, "fifty feet on each side of the marginal limits" of the ditch or reservoir, and the term "marginal limits" has been construed to mean the high water line. The right is also given to take from the adjacent public land material, earth and stone necessary for the construction work, but it has been held that this right is for construction work only and not for repairs or improvements.

The act specifically provides that "the privilege herein granted shall not be construed to interfere with the control of water for irrigation and other purposes under authority of the respective states and territories." The land office accordingly does not attempt to regulate appropriations of public waters but simply insists upon a showing by the applicant that the state or territorial laws governing water rights have been complied with.

The act further provides that if any part of the

ditch shall not be completed within five years after its location the right of way for such part shall be forfeited. Regarding such forfeitures, the Secretary of the Interior has held that the jurisdiction of the Interior Department is lost upon the approval of an application, and any action looking to the cancellation or annulment of the right of way must be brought in the courts. The regulations call for the filing of affidavits on the completion of the ditch or reservoir. If the line of the right of way as granted has been departed from, new maps and field notes must be filed and the right to the original but unused line relinquished.

The act also provides "that no such right of way shall be so located, as to interfere with the proper occupation by the government of any such reservation, and all maps of location shall be subject to the approval of the department of the government having jurisdiction of such reservation." Under this provision the Forest Service has prepared special regulations governing rights of way through the national forests. No construction work in a national forest will be allowed on such rights of way until the application has been approved by the Secretary of the Interior, or unless permission for such work has been specifically given, and as a condition precedent to such approval the applicant must enter into such stipulation and execute such bond as the Forest Service may require. For ditches and reservoirs occupying part of government reservations other than national forests, no application for right of way will be approved by the Secretary of the Interior until it has been approved by the department in charge. If the right of way is upon unsurveyed lands, the map must be filed within twelve months after the official survey thereof, and no application for such right of way can be approved prior to the official survey.

The following paragraph from the regulations clearly states the nature of the grant of right of way under the act of 1891:

> The right granted is not in the nature of a grant of lands, but is a base or qualified fee. The possession and right of use of the lands are given for the purposes contemplated by law, but a reversionary interest remains in the United States, to be conveyed by it to the person to whom the land may be patented whose rights will be subject to those of the grantee of the right of way. All persons settling on a tract of public land, to part of which right of way has attached for a canal, ditch, or reservoir, take the land subject to such right of way, and at the total area of the subdivision entered, there being no authority to make deduction in such cases. If a settler has a valid claim to land existing at the date of the filing of the map of definite location, his right is superior, and he is entitled to such a reasonable measure of damages for right of way as may be determined upon by agreement or in the courts, the question being one that does not fall within the jurisdiction of this department. Section 21 of the act of March 3, 1891, provides that the grant of a right of way for a canal, ditch, or reservoir does not necessarily carry with it a right to the use of land 50 feet on each side, but only such land may be used as is necessary for construction, maintenance, and care of the canal, ditch, or reservoir. The width is not specified.

Act of May 11, 1898: The Act of May 11, 1898, authorizes the use of rights of way granted under the Act of 1891 for purposes subsidiary to the main purpose of irrigation, as is shown by the following clause from section two of the act:

> And said rights of way may be used for purposes of water transportation, for domestic purposes, or for the development of power, as subsidiary to the main purpose of irrigation.

In all cases the applicant must prove to the satisfaction of the Interior Department that the intended use, other than irrigation, is really subsidiary thereto, and the proof must be especially clear where the development of power is contemplated.

Act of February 1, 1905: Section four of the Act of February 1, 1905, authorizes the Secretary of the Interior to grant rights of way through national forests to citizens and corporations of the United States "for municipal or mining purposes, and for the purposes of milling and reduction of ores." The nature of the grant is the same as that under the Act of March 3, 1891, except that no right is given to take any material, earth, or stone for construction or other purposes, and that the right of way is restricted to the strip necessary for the construction and maintenance of the works. Applications are made in the same way as those under the Act of 1891.

Act of February 15, 1901: Although other uses are specified in this act, it is now of importance only in regard to rights of way though the public lands and reservations for reservoirs and canals for the generation of electric power, and for electric transmission, telephone and telegaph lines. It is provided in the act that any permission given thereunder may be revoked by the Secretary of the Interior in his discretion The right granted is a mere license, revocable at any time, and does not carry with it permission to take material, earth, or stone from the public lands or reservations for construction or other purposes.

For permission to occupy land outside of the national forests applications must be made in the same way in general as under the Act of 1891. Where the entire right of way lies within an Indian Reservation the application must be filed with the Commissioner of Indian Affairs.

Rights of Way for Power Purposes Through National Forests.

The Act of February 1, 1905, transferred the administrative control of the national forests from the Interior Department to the Department of Agriculture, so that the revocable license for electrical plants (ditches, reservoirs, transmission lines, etc.) is now given under the authority of the Secretary of Agriculture. The Use Book—Water Power—of the Forest Service sets forth in detail the regulation and instructions regarding such licenses or "permits." The first, second, fifth and sixth paragraphs of the 1911 regulations are as follows:

> REG. L-1. Preliminary water power permits will allow the occupancy of the lands of the United States within national forests for the purpose of securing the data required for an application for final permit and for such construction as may be necessary to preserve water appropriation during that period. Final water power permits will allow the occupancy and use of such lands for the construction, maintenance and operation thereon of works for the

main purpose of the generation of electrical power. Preliminary or final permits for commercial water power works, or for non-commercial water power works of a capacity in excess of one thousand (1000) horsepower, will be granted, extended, and renewed only by the Secretary of Agriculture. Permits for non-commercial water power works of a capacity of one thousand (1000) horsepower or less, and for transmission lines, not a part of any water power works covered by a water power permit will be granted, extended and renewed by the District Forester. The Secretary of Agriculture alone may revoke water power permits.

REG. L-2. The "non-commercial water power works" will be applied to water power works owned and used solely by the permittees for one or more of the following purposes: In the operation of their own mines, or in the milling and reduction of ores therefrom; as auxiliary to irrigation works owned and operated by permittees; temporarily, in the construction of other works for which permission has already been granted the permittees; by municipalities for municipal purposes; or for such other miscellaneous uses not herein enumerated as may be determined by the Secretary of Agriculture to fall within this class. No charge will be made for the use and occupancy of lands for non-commercial water power works. All other water works will be termed "commercial."

" * * * REG. L-5. Occupancy and use of national forest lands is the sole privilege granted under a water power permit. In the issuance of such permits no attempt will be made to adjudicate water rights, since water rights are acquired under state laws and adjudicated by the courts. Therefore no protests against the granting of an application, if based upon alleged lack of water rights, will be considered; nor, in general, will any allegation that the time of beginning or completion of construction has been or is delayed by litigation over water rights be accepted as a sufficient reason for granting any extensions of time.

REG. L-6. Unless sooner revoked by the Secretary of Agriculture, a final water power permit shall terminate at the expiration of fifty years (50) years from the date of the permit, and may then be deemed to be an application by the permittee for a new permit to occupy and use such lands as are occupied and used under the original permit: Provided, That the permittee shall, not less than nor more than four years prior to the termination of the permit formally notify the Secretary of Agriculture that it desires such new permit, and will comply with all laws and regulations at such time existing, regulating the occupancy and use for water power purposes of lands of the United States within the national forests.

Applications must be filed with the District Forester of the district in which the lands to be occupied are situated. In approving an application the time for beginning and completing construction is specified. Before a final permit for commercial water power works can be secured, the applicant must execute a stipulation providing among other things for the payment annually in advance of such charges as may be required by the Secretary of Agriculture, for the installation and maintenance of approved hydraulic measuring devices, and for the inspection of books and records showing stream flow and reservoir data and amount of electric energy generated.

Special State Legislation Regarding Water Rights for Power Purposes.

As previously stated, water rights for all purposes are generally considered to exist as long as the use continues, but water rights for power purposes have been limited to fixed periods in California and Oregon. The latter State in 1909 fixed the period at forty years with a preference right of renewal, for a period then fixed by law, and California, at the regular legislative session of 1911, fixed the period at twenty-five years, but changed it to forty years at the special session of the same year. Each State by its new legislation levies an annual charge for power development depending upon its magnitude.

This special water power legislation was undoubtedly suggested by the regulations of the Forest Service. It is an attempt to regulate the so-called "power monopoly"—the underlying idea being that no permanent rights should be given and that the power company should in a small measure share its earnings with the State. Regarding the Oregon legislation State Engineer Lewis in his Third Biennial Report, (1909-1910, pages 82, 83) says:

The annual tax idea seems to be based upon the fact that water is the property of the public, and those who enjoy a right to its use should pay something to the state for the privilege. It was not recommended or approved by the Oregon Conservation Commission. Whether the basis for electric power charges will be to "charge all the traffic will bear" as in railway rates, is a matter of uncertainty. The price of electric power is being constantly lowered through competition with steam producer gas, etc., where the cost of production has been greatly reduced in recent years through improvements in methods and machinery. Only those water powers will be developed where the cost of production will permit successful competition with these other power producing agencies. If, in addition to the necessary development cost a heavy annual charge per horsepower must be paid the state, it is conceivable that such charge may defeat rather than promote the conservation idea, as well as retard development. We will be consuming our limited supply of coal, for economic reasons, while our water power remains undeveloped and goes to waste year after year.

Comments on Water Power Legislation.

A little reflection should suggest that the present special legislation regarding water power falls far short of the desired goal—the protection of the public. When the right of way act of February 15, 1901, was passed, little was known of practical rate fixing and the revocable license appealed to many as a needed curb. Later the annual charge was fixed by departmental regulation. The legislation and regulations are especially designed for the "commercial" power companies—that is, those engaged in public service. The right of the state to regulate public utilties and fix the rates of public service companies is now undisputed. For years the rates of water companies have been fixed throughout the entire country, later the railroads were taken in hand, and now public service commissions in a great number of states have been empowered to fix the rates of every public service company. The movement is so wide-spread and has been so generally accepted without litigation by the companies involved that its adoption by every state in the near future is certain.

Being assured that the state can and will insist upon rates which are reasonable, all that remains is to prevent the state or nation from giving to a public service company a property right which may be capitalized. Thus far no such preventive action has been

taken. Although the permit to occupy the public lands is revocable and the water right in California and Oregon is but for a fixed period, they are rights which are bought and sold and on which the company expects the consumer to pay a good return. Likewise the annual charge made by state and nation must be paid by the consumer—even where rates are fixed by a commission, as it is a legitimate operating charge.

It is now generally conceded that the fixed period idea is wrong economically. Although a preference right to continue after the end of the period is promised the permittee, it is subject to future legislation, the nature of which can not be prophesied. The result is that the operating company must charge a comparatively high rate in order to return the capital invested within the fixed period, and the chance of poor maintenance near the end of the period is decided.

Many state and federal officials are now ready to recommend an indeterminate license in place of the fixed term or revocable license. The indeterminate license is to be granted subject to the condition that the works may be taken over at any time by the state, or other public unit, at a valuation to be fixed by the state public service commission. As such taking is very unlikely in any given case and as it will become more and more so as the public service commission become older and stronger, the indeterminate license has almost the assurance of a perpetual right, conditioned only on proper operation. If such license is granted on the further condition that no rights of way, franchises or water rights secured from the state or nation can be capitalized for either rate fixing purposes or in cases of taking as above, the public is certainly protected in full measure.

State Versus Nation.

During the past few years withdrawals from entry of public lands for power sites have been made in large numbers. The Land Classification Board of the United States Geological Survey has charge of the examination of such withdrawn lands, and all future applications for rights of way for power purposes over public lands outside of national forests will be passed upon by the engineers of the board.

Comparatively recently a movement has been gaining weight to have the nation transfer the "power site withdrawals" in trust to the states. To many, of whom the writer is one, this suggestion is a step backward. In the last article attention was called to the doubtful water rights of interstate ditches. If the suggested step be taken the right of way of such ditches would be equally doubtful and the same question would be raised regarding interstate transmission lines.

In all phases of legislation the struggle should be for uniformity. There are but two federal departments concerned in the regulations regarding rights of way and the minor differences in their points of view are being rapidly eliminated. It would take many years to bring the many western states into such unison. Conceding for the purposes of argument only that the technical men of the federal bureaus are not better trained than those in the state offices, the longer period of service and greater freedom from politics are sufficient to make the federal bureau the more effective. It must be remembered also that in each of the western states land matters and water matters are handled by different offices having little or nothing in common. The embarrassment would be thus increased.

A real difficulty in the way of an early settlement of the whole question is that the present is a transition period. The public service commissions with their full control of all public service companies are so new that their existence is either not recognized or their worth is questioned. When they have demonstrated their efficiency there will be no further excuse for either federal bureaus or state water commissions attempting to regulate the power business. It has been shown that the state and not the nation has control of water rights. There is no more reason, therefore, for the nation charging an annual tax depending upon the amount of power developed—which, of course, is a function of the water right—than there is for demanding of a railroad company, as a condition precedent to grant of right of way, that it must pay an annual charge depending upon the traffic handled. The nation as owner of the land should give a right of way or indeterminate license conditioned upon construction within a specified time and leave the question of regulation to the state public service commissions.

To repeat, the future congressional and state legislation regarding water power development will depend upon the state public service commissions. If they prove efficient, as there is every reason to believe, the public should insist that all other agencies stay within their proper spheres and stop tampering with the regulation of public utilities.

CALIFORNIA COMMISSION NOTES.

The Home Telephone Company of Covina has applied to the Railroad Commission for permission to sell 369 shares of common stock at $50 a share. It desires to use the proceeds to take up notes to the amount of $16,500. The Home Telephone Company of Covina has an authorized capital stock of $200,000. It operates in Covina and Azusa.

The Peoples Water Company of Oakland has applied to the Railroad Commission for authority to issue a note in the sum of $71,000 and to pledge therefor as collateral security bonds to the amount of $100,000. The note is to carry six per cent and to be placed with the Central National Bank of Oakland to take up other notes.

The Western Union Telegraph Company has presented to the Railroad Commission a revised schedule of rates and has asked that it become effective on July 1st. The schedule contains a number of reductions covering a wide section of the state. An application for similar reductions was made to the Commission in May by the Postal Telegraph Company. The rates as now proposed by the Western Union would bring the two schedules to approximately the same basis. The matter will be given an early consideration and if the Commissioners find no objection, the rates as revised will go into effect on July 1st.

REGULATION OF WATER POWER DEVELOPMENT.[1]

BY E. G. HOPSON.

In countries like Australia practically all public service is under public control, and communities desiring state or municipal improvements apply to the government both for designs, construction and operation of works. In some European countries similar conditions obtain, and government control has thus become thoroughly incorporated into the social structure. In this country privately owned and controlled public service corporations perform most of these functions, particularly in connection with light and power. These concerns have developed great systems of works and occupy practically the entire field. The water powers remaining under state and federal control are mostly undeveloped and, to a very large extent, are located in the more remote localities, so that they are not immediately available for use in the logical order of commercial development.

It may be possible to devise a scheme for developing these water powers by the direct action of the government or state, or both, but it should not be overlooked that this will not mean complete government ownership of light and power, but only a share of the field, the private concerns being already well intrenched in the most strategic points. What would be the outcome if the government proceeded to develop the new powers in competition with the privately owned power plants already built is another matter.

First of all, the government would be competing with its own citizens in commercial work, which is an undesirable situation. Such competition, however, could only end in one way, as the resources of the government are so much greater than those of the largest private interests. If the government seriously undertook rate cutting regardless of economic considerations, the private concerns would be forced out of business or would be absorbed by the government itself. In all probability no actual competition will result, as private interests, realizing the situation would surrender at the outset. What, however, would be the object of such competition? Would the purpose be to drive out private ownership or merely to control it? The latter having generally the best strategic positions today, could, if their resources were equal to those of the government, win out in any rate-cutting competition. The entrance of the government into the field with the avowed policy of rate cutting would, however, necessarily be the end of all private enterprise.

Is this the result we are after? It seems to me the point to be attained is not the elimination of private enterprise, but the securing of reasonable rates to the consumer. We are not yet ripe for the wide adoption of government ownership of this utility, i.e., to the extent of ousting those already engaged in the work. We do, however, desire to prevent unjust and unreasonable rates. Monopoly cannot be avoided, nor does it appear worth while to make any attempt so to do. Production of power is cheaper and more reliable by large plants than small ones, and monopoly there must be either under public or private control. I believe the public will be sufficiently served by rate regulation of all light and power corporation coupled with governmental examination and supervision of the business methods and accounting of the operating concerns.

The public will be satisfied if these corporations obtain a reasonable profit, because, after all, that is what everybody is looking for, provided their methods are reasonably well conducted and efficient. It does not desire to control or operate these plants, as that would involve a governmental machinery far too complicated and cumbersome and might entail evils greater than such excessive rates as may obtain in some cases

It therefore seems to me that the state and federal government should not embark on a policy of wholesale construction and development of the new water powers with a view to using such action as a club over the private interests already operating, but should proceed, first, to perfect machinery to supervise and regulate them in the interests of the general public, with due regard to the legitimate rights of the investors in such concerns, and, secondly, methods should be devised for the development of the new powers to keep pace with the growing needs of the community.

Whether the development of the new water powers can best be handled by public or private means is a matter for consideration. In some cases private capital can probably be used to the best advantage, subject, of course, to regulation and control. In other cases, where large comprehensive schemes beyond the scope of private enterprise are involved, the work can be best handled by federal or state authority. It seems to me, however, that no arbitrary rule can be made covering all cases, and it appears particularly inadvisable in our present incomplete knowledge of the technical features of any proportion to dogmatize as to its merits or demerits.

The point on which we will probably all agree is that some expert body should carefully consider and weigh these matters and try to devise a plan for recommendation to the state government, possibly to congress. My present idea is that the state should in any event appoint a public service commission empowered thoroughly to scrutinize the business of all light and power corporations operating in the state and should legislate to compel all such corporations to make regular reports to the commission and to submit its accounts to the inspection of the commission, as may be required, and to fix no rates for sale of power save with the approval of the commission. This seems to be the first and most necessary step. It will establish the principle already partly established in other states, that these concerns are not of a purely private character; that the public affording them facilities to carry on their business, insists on a share of control of the business and reasonable rates. This principle once established may be capable of wide extension as recognition of the rights of the public becomes enlarged.

In addition to the control of existing power companies by a public service commission, we are faced with the necessity of providing for the development

[1]Paper read at the Commonwealth Conference of the University of Oregon, May 25, 1912.

of the new powers, this development being now practically held in abeyance through a deadlock between state and federal action. The state claims to own and control all waters of the state and has provided legislation and machinery for the purpose. In the majority of cases of the large undeveloped powers in this and other western states the sites are still in public ownership, and these lands being withdrawn from entry in furtherance of the policy of conservation and development being therefore impracticable.

The present condition is anomalous and should be terminated. I know of many worthy plans for development that would have been started to the great public advantage but for this deadlock. As matters now stand there is no legal provision for regulating the entry of these lands. The present withdrawal must, therefore, continue until congress takes action of some kind. What this action will be is entirely in the air. One school advocates the most radical system of government ownership, while others would be willing to restore these lands to entry with little, if any restriction. It may however, be taken for granted that these power sites will never be opened to unrestricted entry as in the past. Some control and regulation will be established, and this is where the state can greatly aid congress by its advice and co-operation.

Under the new Oregon water code a system of fees has been established on all water power development, the amounts being proportioned to the power developed. While unquestionably this system is far in advance of what existed before, it does not quite appeal to me as being the kind of control best suited to the public interest. Whatever the amount of the fees may be, they are merely a tax on the consuming public, it being evident that the power companies will ultimately shift the burden to the consumer. The entire principle of establishing fees is wrong unless we regard the question purely as a revenue-producing one and select power development for taxation simply on this basis. As now applied, it is similar in effect to that of an internal tax on coal paid by the mine operators for each ton produced at the mines, in which case there would be little doubt that the public would bear the burden and not the mine operator. It seems to me we do not need taxation or fees, but rate regulation or public ownership and operation. In all probability both the latter will be beneficial under the diverse conditions that obtain in different localities.

Rate regulation is unquestionably a long step toward public ownership, and it takes no vivid imagination to picture the growth of one into the other as time goes on. It seems, however, to go a long way in meeting the desire of a large portion of the public for some kind of positive control by the public of public utilities. It provides at the same time a reasonable outlet for the energy and activity of private enterprise and an opportunity for the utilization of great masses of private capital available for profitable development. Properly devised regulation of rates means stable investments at reasonable profits because the prohibition of excessive profits through the action of a public service commission should entail a corresponding duty on the part of the public to insure reasonable returns on the invested capital and full public support in emergencies. From an investment standpoint regulated corporations should enjoy a stability and assurance that will eventually be found more attractive than the speculative features incident to those operating without regulation.

Actual public ownership and operation is not, in my opinion, a thing to be entered into too lightly. The machinery of the state and federal government is not suited for such burdens, nor is the public educated politically to a grade that will afford reasonable assurance of sustained efficiency in the operation of great public works entering intimately into the daily economics of the people. Almost the only government branch constructing and operating works that I know to be reasonably effective and economical is the Reclamation Service, and I have a full appreciation of the difficulties we live under in that organization in keeping our record even passably good. There is an irresponsibility and indifference to current events in the great public departments that is most discouraging, and I believe the relatively effective condition of the Reclamation Service is principally due to its newness and its relative unimportance among the other government bureaus.

If the activities of the government were spread over a wider area it would be with greatly increasing difficulty that a respectable average of efficiency could be maintained, unless the public itself became more alive to the vital interests at stake and enforced departmental reorganization.

In order to enable private enterprise to develop the water power where the sites have been withdrawn by the Interior Department, congress must pass legislation, and here again the voice of the state should be unmistakable. This is mainly a matter for expert advice as to the best means to secure full public control of the essentials and yet render development a reasonably attractive field for private enterprise.

There is no doubt in my mind that this problem can be solved if handled by experts and kept out of politics. It appears to me that any plan recommended to congress should include in any event that the power sites now withdrawn be granted to the state for entry and utilization, subject to public welfare rules, probably limiting the tenure, providing for approved methods of construction, utilization, operation and rate regulation. Prior to the opening of any of these sites there would seem to be necessity for action by a joint commission of federal and state officials in a complete examniation of each locality affected, and decision as to policies to be adopted in such matters as the continued reservation by the government of such sites as may be needed by the government or state.

EXTENSION OF TERRITORY AT PANAMA.

In a decree issued by the President of the Republic of Panama, under date of March 29, 1912, described as resolution No. 22, public proclamation was made that the Republic of Panama no longer exercises any authority in the area to be covered by Gatun Lake, which extends beyond the lines of the 10-mile strip, the same having passed into American control in accordance with the canal treaty.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

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CONTENTS

Beautifying the Highways

The continued agitation looking toward better and more efficient roads throughout the West is certainly deserving of the liberal and loyal support it is receiving. Western Montana, in which is located the famous Bitter Root Valley, noted for its McIntosh Red apples and Bing cherries, now comes to the front in a proposal to construct a road the whole length of this fertile valley with apple and cherry trees lining the project the entire distance.

This idea has been worked out in a self-supporting manner in several of the smaller countries of Europe although definite data is not at hand to tell whether these roads are located through an arid or semi-arid country requiring the use of water for maturing orchard crops. In these countries, however, the crops from the trees along the public highways are carefully gathered and the sale from them is found to be sufficient to maintain this beautiful custom.

Nothing adds to the stateliness or dignity of a great public highway more than an embroidered growth of some sort. Instances may be cited from recent eastern accomplishments along these lines. The New York State Department of Highways is to commence the systematic planting of trees along the improved highways under its jurisdiction. The Department has bought recently 150,000 red oak seedlings and 15,000 Carolina white birch trees for the purpose. In taking this step the New York officials are following the excellent example set by the Massachusetts State Highway Commission. This commission for a number of years has been planting trees along its improved roads. It has had its own nursery and its own forester. The tree planting has thus been done scientifically and systematically, and the results have been highly satisfactory.

In California it is gratifying to follow the broad ideals and high purposes held in view by those having in charge the spending of the $18,000,000 upon state highways voted some months back. Though such a sum is enormous in many respects, yet it is only a beginner in funds that should be set aside for this work. Indeed, the permanent and substantial plans now being prepared by this commission could never be consummated in completeness without additional millions.

Oregon, Washington and other western states are likewise voting fortunes in bonds for the furthering of good roads. Through it all, however, the aesthetical and indeed the practical results to be accomplished by embroidering these masterpieces of road structure wherever found expedient with trees, plants and other western activities are beyond human conception.

Someone has suggested that along with the trees, orchards and other vegetable matter proposed, why not embroider the roads with a power plant here and there. The wit who made this suggestion evidently is ignorant of the fact that there is more truth and sound argument in his suggestion than would appear at first sight. An old adage has indeed long ago informed us that "full many a truth is said in jest."

Power plant owners in many sections of the West

have long since felt the necessity of improving roads leading to their hydroelectric installations. Many of these constitute the most picturesque sights to be found in our Western Empire. Such accessibility to these great engineering triumphs makes the tourist of today, who is the investor on the morrow, more enthusiastic than ever in the future of the West.

In conclusion, then, let all interested in the welfare of the West and particularly those of us engaged in hydroelectric enterprises continue to boost for good roads, for increasing their efficiency and where possible for their beautification.

And along with this beautification, may western roads be embroidered where possible with apple trees, cherry trees, and a thousand western products never forgetting occasionally to connect up a side avenue to exhibit the greatest product of all—the western power plant.

Photography in Engineering Work

The courts bear record of the fact that much litigation has been effectively brought to a close by exhibitions of systematic and detailed photographs of construction work covering points at issue. Not alone in the courts, however, is the engineering photograph of value to the corporation. The careful filing of photographic records prove of incalculable service, especially in the matter of cost keeping; the daily progress of work can hardly be shown in such detail in any other manner. A series of photographic records exhibiting the manner of handling a new and delicate engineering feat tells its mute but realistic story beyond description in words.

So convinced of the efficacy of photography are many of the hydroelectric managers of the West, the subject of systematic office arrangements and methods for engineering photographic work is of timely and intense interest. In addition to the careful planning of proper rooms for efficient work, the manipulation or processes undergone in the production of a finished picture are strictly technical and in view of applications to engineering structure and reconnaisance, new ideas have been evolved distinguishing this separate art from the broader field of photography as generally practiced. The exposure, development, fixing, washing, drying, and retouching of the plate; the printing of the negative; the developing, fixing, washing, drying and mounting of the print—all these subjects must be carefully studied and mastered before engineering photography becomes a success.

On another page of this Journal will be found the beginning of a series of articles on photography in engineering work with special attention to office arrangements and methods. In succeeding issues will appear in consecutive order a discussion of the interesting details necessary in perfecting this new weapon of modern engineering equipment. The methods as given have been put into successful practice in one of the great hydroelectric companies of the West.

Mr. M. R. Lott, the author of this series of contributions, speaks with the force of technical training and experience. As an engineering graduate of Michigan with further investigation in the graduate school of applied science at Harvard, Mr Lott undertook this phase of engineering work in the Telluride Power Company at Provo, Utah, where he brought it to a successful and efficient stage of operation. That the executives of the Telluride Power Company realized the benefits and conveniences to be derived from the use of photography in engineering work can easily be gleaned from the methods advised by Mr. Lott, and the care shown in picking out the best methods in every detail indicates that good results are largely dependent upon attention to the minute factors that enter.

A Bad Law That Should Be Changed

The legislative enactment by the California State Legislature known as chapter 499 of the statutes of California, if it were not such a serious matter, for clear unadulterated consistency and engineering ingenuity, might legitimately be called a good joke. This act sets forth certain provisions regulating the placing, erection, use and maintenance of electric poles, wires and appliances. The statute also provides severe penalties for infringement.

One especially inconsistent and notoriously uncalled-for provision in this act is that relating to the size of the conductor at crossings of public highways. The statute provides that at crossings where wires are carrying a voltage higher than fifteen thousand, the cross-sectional area of the conductor shall equal at least twice that used in the line outside of such crossing. A strict interpretation of this would simply mean a stretch of wire of double cross-section long enough to cover the highway from one end to the other in its span would be sufficient. It is absurd to maintain that such a law adds one iota to public safety. Indeed, it is far more reasonable to believe that the added splicings may tend to weaken. It is easy to imagine that a cautious company in crossing two highways situated relatively near each other may decide to run the double area of cross-section the entire distance covering both highways. But even, then, though a far superior construction has been brought about, the law has been evidently infringed, for the company must again double the cross-section at the crossing or expose themselve to a $500 fine or imprisonment in a county jail not exceeding six months.

Still another confusion exists as to who has jurisdiction in the matter. The law would seem to indicate that the district attorney in each county should bring action in case of infringement. The new public service commission act is definite, however, in giving full authority to the railroad commission to investigate the cause of accidents and to take steps to prevent their recurrence. The closing clause of the public utilities act passed March 23, 1912, definitely repeals all acts or parts of acts inconsistent with the provisions of the utilities enactment.

A movement is on foot to change this law to meet reasonable and safe methods in the lines attempted in the present statute. The Journal will gladly welcome all suggestions that may be contributed. These will be tabulated and placed before the executives of the various interests at stake under the enactment in order bring about a unified action.

PERSONALS.

L. R. Wiley, a hydraulic engineer, is a recent arrival from Groveland.

G. L. Priest, representing Otis & Squires in their Portland office, was in San Francisco last week.

A. E. Wishon, of the San Joaquin Light & Power Corporation, is a recent arrival at San Francisco from Bakersfield.

H. N. Tracy, an engineer of Los Angeles, has arrived at San Francisco.

J. A. Lighthipe, an electrical engineer of Los Angeles, arrived at San Francisco from the north with Mrs. Lighthipe, during the week.

Wynn Meredith, of Sanderson & Porter's San Francisco office, is visiting Mexico on an investigation connected with a mining enterprise.

R. A. Ballinger, former Secretary of the Interior, gave an interesting address before the recent N. E. L. A. convention at Seattle.

L. H. Conklin, representing Brooks Bros., who own ten electric power plants, including the one at Warren, Pa., has arriveu at San Francisco from Seattle.

A. H. Halloran, managing-editor of the Journal of Electricity, Power & Gas, is at Portland. Mr. Halloran is rejuvenating his youth, as Astoria was his former home.

Henry E. Warren, sales engineer of the Lombard Governor Company, is at San Francisco, making his headquarters with Pierson, Roeding & Co., the Pacific Coast agents.

Chas. F. Gilcrest, instructor in electrical engineering at the University of California, is engaged in special study in connection with the smelter smoke prevention problem.

F. S. Hunting, president of the Fort Wayne Electric Works, is a recent arrival at San Francisco and is the guest of G. I. Kinney, the company's Pacific Coast representative.

S. L. Shuffleton, who has general supervision of the operations of the Stone & Webster Engineering Corporation on the Pacific Coast, visited San Francisco during the past week.

A. B. Domonoshe, instructor in mechanical engineering at the University of California, has returned with a blushing bride, after a disappearance of two weeks on a honeymoon trip.

Thomas Whaling, manager of the incandescent lamp department of the Westinghouse Lamp Company, of Bloomfield, N. J., visited San Francisco after attending the N. E. L. A. convention at Seatte.

Frederick Herman Kreismann, the Mayor of St. Louis, who was in attendance at the National Electric Light Association, has arrived at San Francisco from Seattle, accompanied by George D. Rosenthal.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company, and Assistant Hydraulic Engineer Trowbridge will attend the annual meeting of the American Society of Civil Engineers at Seattle next week.

G. H. Atkin, manager of the Chicago office of the Electric Storage Battery Company of Philadelphia, and **H B. Gay**, the Cleveland manager, are among the "post-convention" visitors at San Francisco. They will return to the East via Denver.

J. P. Jollyman, engineer of electric construction with the Pacific Gas & Electric Company, made an inspection tour of some of the principal electric power plants of the Pacific Northwest after attending the N. E. L. A. Convention at Seattle.

R. T. Guppy, formerly in charge of the Southern Pacific suburban electrification construction for Oakland, Berkeley and Alameda, has resigned to take complete charge of the electrification of the Southern Pacific lines out of Portland, Ore

John Coffee Hayes, president of the Mt. Whitney Power & Electric Company, together with his brother **Harry Hayes**, head of the company's commercial department were recent San Francisco visiters on their return from the Seattle N. E. L. A. Convention.

Among the group of representatives of H. M. Byllesby & Co.'s interests who visited San Francisco after attending the N. E. L. A. annual meeting were: Messrs. **A. P. Jackson** of Mobile, Ala.; **H. H. Jones** of San Diego, **H. L. Jackman** of Eureka and **W. W. S. Butler** of Stockton.

E. O. Edgerton of the State Railroad Commission recently visited Southern California. At Los Angeles he heard the Holton Power Company's application for permission to issue $300,000 in bonds, and at Bakersfield the application of the Bakersfield Water Company to incur an indebtedness of $50,000.

S. Waldo Coleman, manager of the Coast Counties Gas & Electric Company, recently presided over a gathering of over two hundred employees of the company at a grand picnic in Laveaga park at Santa Cruz. Mayor Stone of Santa Cruz took occasion to publicly praise the company living up to their ideals—"The people be pleased."

John Crawford, Jr., manager of the Noble Electric Steel Company's electric iron smelter at Heroult, and **R. E. Frickey**, chief electrician at the plant, were recent San Francisco visitors. A second furnace is being constructed and the old furnace is being altered to permit of using 12-inch electrodes, increasing the capacity to 20 tons a day.

Harry M. Hope, assistant to F. N. Bushnell, engineering manager of the Stone & Webster Engineering Corporation, passed through San Francisco with Mrs. Hope during the past week, after attending the National Electric Light Convention at Seattle. They will return to Boston via Del Monte, Los Angeles, Texas, and Keokuk, Iowa, where there is a big hydroelectric development.

Among the representatives of the Westinghouse Electric & Manufacturing Company who visited San Francisco and were entertained by the management of the San Francisco district office of the company after attending the N. E. L. A vonvention, were: **B. S. Manuel**, manager of the detail and supply division at Denver; **J. S. Tritle**, district manager of the company's Kansas City office; **J. A. Brett**, district manager at Cincinnati, O.; and **J. W. Busch**, connected with the company's Chicago office.

Hans von Schulthess, a consulting engineer of Zurich, Switzerland, was a recent San Francisco visitor. Mr. Schulthess is a son of a prominent Swiss banker who handles extensively American hydroelectric securities. An eighteen month study of American hydroelectric enterprises has been undertaken in order to post foreign houses regarding the stability of American securities of this nature. Mr. Schulthess attended the N. E. L. A. convention at Seattle, from which city he departed to Alaska.

E. R. Northmore, superintendent of the Los Angeles Gas & Electric Company, was a gracious host at a dinner at the Savoy Hotel in Seattle during the recent N. E. L. A. convention. The purpose of the dinner was to start an agitation looking toward bettering law No. 499 in the statutes of California relating to overhead crossings The following guests were present: **P. M. Downing**, and **A. R. Thompson**, of the Pacific Gas & Electric Company; **Robert Sibley**, editor Journal of Electricity, Power & Gas; **E. Sproule** and **E. L. Beal** of the Great Western Power Company; **L. N. Peart** of the San Joaquin Light & Power Company; and **F. G. Hamilton** of the Mt. Whitney Power & Electric Company.

Among the General Electric Company's heads of departments who visited San Francisco after the Electric Light Convention were the following: **C. W. Stone**, manager of the lighting department, of Schenectady; **E. E. Gilbert**, manager

of the steam turbine sales department; **F. G. Vaughan**, manager of the meter department; **M. O. Troy**, manager of the transformer department; **D. B. Rushmore**, engineer of the power and mining department; **J. R. Lovejoy**, third vice-president of the company, and **N. R. Birge** of the arc department; **E. F. Gehrkens**, engineer transformer department, Pittsfield; **H. L. Monroe**, manager railway department, Chicago; **A. D. Page**, manager, incandescent lamp sales department, and his assistant, **G. C. Osborn**, Harrison; **G. D. Rosenthal**, manager St. Louis office; **R. E. Moore**, assistant district manager, Philadelphia; and **S. L. Whitestone**, auditor, Schenectady, and **O. K. Baylor**, of New York.

ELECTRICAL CONTRACTORS' NOTES.

The following notation from the Chief Electrical Inspector is of timely interest to all electrical contractors:

To All Concerned:

Local Rule No. 48 refers only to concrete floors, or concrete floors covered with wooden flooring, and in damp and wet places.

Under conditions other than above, any approved flush receptacle will be passed favorably upon when installed in accordance with other local code rules.

To All Electrical Contractors:

When filing applications for inspection, the following blank spaces must be carefully filled in:

"Street and No.," "Owner," "Tenant," "Architect," "Occupied as," "Inspect," "Class of Building," "No. of Stores," together with the number of outlets, switches, plugs, lights, circuits and service.

If for motor installation, size, class, voltage and size of feeds must be filled in.

The above rules will be insisted upon, for the purpose of enabling this office to have proper records of all jobs, and any reports not properly made out will be returned for correction.

GEO. FISK,
Chief Inspector

The Central Electric Company has been awarded building of seventeen flats on the corner of Jackson and Gough streets.

Bids are being taken for a number of good electric jobs, among which are the State Armory, amounting to $14,000; Geary-street car barns, $15,000; Holbrook job, Sutter and Grant avenue, $15,000; Boston Amusement Company, theatre, $15,000; Wilson job, Mason and Lutheno place, $7,000.

The city inspectors throughout the State are going to attend the California State Association of Electrical Contractors' meeting at San Jose in a body.

John Rindler and W. S. Hanbridge, directors from California to the National Association of Electrical Contractors, and E. F. Burkhard, Louis Luy and W. A. McNally will leave in the early part of July to attend the convention at Denver. They have promised to bring back some of the Eastern delegates to attend the State convention in San Jose.

Oregon's delegates will be in San Jose according to a letter from Secretary Tomlinson of Portland Local.

Visitors' tickets for the State Contractors' Convention are now out and can be obtained from any of the local contractors. The price is $5 for a book of six tickets. Coupons will admit holder to go on three excursions, attend theatre party, annual dinner and Electric Trades Picnic.

S. A. Pacheco, manager of Luna Park, was in town Tuesday and has turned Luna Park, with the ball grounds, over to the Contractors for July 27th. Messrs. Aimes, Cohn and Faser promise the electrical people a treat that they will remember for a long time. All kinds of games for young and old, plenty to eat and drink, music for those who dance, baseball for the fans, and a good time for all.

An item in the Daily Commercial News refers to the increased price of electrical material and in a slurring manner refers to preparations of the electrical people getting ready to boost prices. The only foundation for such a report is on account of the fact that the new Code wire is just being placed on the market and it means that in the future a higher grade of insulation will protect the users of electricity from fire hazards. The increased cost is not worth talking about. No doubt the writer of the above article has been in the hands of some contractor who is afraid that he will make too much money and has recommended the use of cheaper material to close a deal.

Frank Somers of San Jose was in town Monday.

A number of the local contractors have started a luncheon club in the main dining room of Campi's Restaurant, which meets daily. Many local problems will be settled over the board, but at present there is a three-cornered deadlock of national repute—Roosevelt, Taft, Clark.

MEETING NOTICE.

The American Institute of Electrical Engineers meets in annual convention at Boston, June 24-28. A most interesting program has been prepared. The social features which begin with a reception and dance at the grand ball room of the Hotel Somerset, on Monday evening, and end with the institute banquet on Thursday evening promise to be unusually brilliant. The papers are more numerous than ever and will constitute food for serious reflection for the engineering fraternity for many months.

ELECTRICAL LEAGUE OUTING IN LOS ANGELES.

The following are details of the Electrical League outing to be held at Balboa, June 29, 1912:

Special trains will leave on Los Angeles street in the rear of the Pacific Electric building, at 9 a. m. going, and will leave Balboa at 5 p. m. returning. Tickets will be 75 cents for the round trip; children from 5 to 12, 40 cents; under 5, free. The tickets will be good on any Balboa car during the entire day and the ticket holders are not restricted to the special trains. There will be many new and novel sporting events for which many prizes will be given and in which all are welcome to participate. The outing is for all in the electrical business who desire to attend and their friends are all welcome also and is not exclusive in any way.

All electrical houses in Southern California are expected to close on this day. Coffee will be served on the grounds free.

BOOK REVIEW.

Toll Telephone Practice. By J. Bernhard Thiess, B. S., LL. B., and Guy A. Joy, B. E., with an introductory chapter by Frank F. Fowle, S. B.; size 6½x9½ in.; 418 pages; 273 illustrations; cloth binding. Published by D. Van Nostrand Company of New York and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $3.50.

The rapid rise of the telephone art during the past two decades has now made it impossible to completely discuss all phases of the art in one comprehensive volume. Common usage among telephone men has led to the general classification of telephone service under four headings—local, suburban, toll, and long distance. The last three are broadly classed under the general heading of toll telephone service and hence these constitute the subject matter of the book under discussion. The book opens with an introduction by Frank P. Fowle, the well known telephone expert. In this chapter the development of the telephone art is interestingly treated from an historical point of view. Twenty-five chapters next appear treating of the principal subjects connected with toll practice. The various switchboard systems are described. Simplex and composite systems with line construction problems, including methods of testing, are systematically and logically treated. The chapter on phantom lines, though brief is nevertheless well treated and ably affords the reader the fundamental considerations entering this important branch of telephony. The book will prove a needed addition to those engaged in telephone engineering or in the construction of toll telephone equipment and installation.

INDUSTRIAL

A 600-1200 VOLT DIRECT CURRENT FREIGHT LOCOMOTIVE.

A 47-ton standard gauge electric locomotive has recently been added to the rolling stock of the Oakland, Antioch & Eastern Railway, for handling its freight service. This system when completed will make a network of lines totalling about 156 miles, extending out from Oakland, California.

Locomotives are productive of a considerable revenue to electric roads; and also, as in this case, no complications necessarily arise as to maintenance, since the locomotive control parts and car control parts are interchangeable. This considerably reduces the number of kinds of spare parts to be carried in stock; and thus results in simple, low and efficient maintenance.

600-1200 Volt D.C. Freight Locomotive.

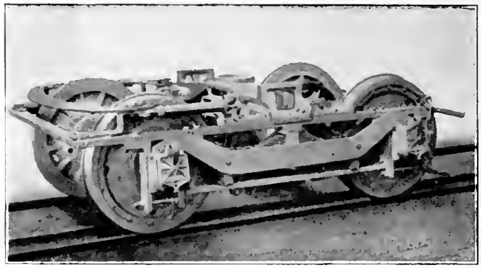
The mechanical parts were furnished by the Baldwin Locomotive Works, Philadelphia, while the electric equipment was furnished and installed by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The locomotive is of the well known double truck type with steeple cab. It is arranged for double end operation and can traverse curves of 50 feet radius when hauling a trailing load.

The trucks are of the equalized pedestal type, with one piece forged iron frames and rigid cast steel transoms. The pedestals and pedestal braces are of forged iron, and the pedestal binders of malleable iron. The transom gussets are of cast steel. They have ample bearings on the frame and transom, and act as brake lever guides and brake shoe hanger supports. The brakes are inside hung and are applied through a radial beam, which is supported on the inner end of the truck frame. The wheels have cast iron plate centers with steel tires which are shrunk and bolted on.

The locomotive frame is of steel, built up, and is composed of commercial shapes as far as possible. The longitudinal sills are four in number, and they consist of 12-inch channels. Between the middle and outer channels, on each side is worked a strong arrangement of diagonal braces composed of 6-inch channels. The end bumpers are of steel plate ⅞ in. thick and 20¾ in. deep. The draw castings, which are of steel, are riveted in place between the center sills and back of the bumpers, and are arranged to take long shank radial couplers of the M. C. B. type. The bolster plates over the trucks are 66 in. wide and are substantially braced to provide the necessary stiffness. The bolts, which secure the center pins to the plates, also pass through the flanges of the middle frame sills. The various parts composing the frame proper are held together by ⅞ in. rivets.

The cab is of steel and is centrally located. The ends of the locomotive are covered by hoods, under which are placed the switch groups, reversers, resistors, dynamotor compressor and other equipment. The cab is entered through side doors and has large end windows, so that unobstructed views can be obtained above the hoods. Steps and handholds are arranged in accordance with the requirements of the Interstate Commerce Commission. The width of the cab and hoods is less than that of the frame, and there is room for a continuous running board from end to end on each side if the locomotive.

This locomotive is fitted with an iron pilot at each end, air sanders with spouts to all the wheels, combined air and hand brakes, two air whistles, and two electric headlights.



Baldwin Type Locomotive Truck.

A standard locomotive bell with pneumatic bell ringer is mounted over one of the hoods. The principal dimensions are as follows:

Truck wheel base, 7 ft. 4 in.
Total wheel base, 25 ft.
Distance between truck centers, 17 ft. 8 in.
Driving wheels, outside diameter, 42 in.
Driving wheels, center diameter, 37 in.
Journals, American Electric Railway Association, standard, 5 in. x 9 in.
Width over all, 10 ft.
Height to top of cab, 12 ft.
Length between coupler knuckles, 35 ft.
Total weight, 98,100 pounds.
Estimated weight of mechanical equipment, 57,000 lbs.

For propulsion, this locomotive is supplied with four Westinghouse No. 308-B-6, 120 h.p., 600-1200 volt commutating pole railway motors with a gear ratio of 19:54. The driving wheels are 42 inches in diameter. Box type of frame construction is used, the frame being cast in one piece of steel with large openings at each end for bearing housings and taking out the armature endwise.

This motor is of the slow speed type and particularly adapted to freight haulage, for with a motor of this type heavy loads can be handled with but a comparative small increase in power consumption for a system.

Control of the HL unit switch type is used. The motors are in series and parallel with each other in conjunction with the necessary resistance to produce smooth acceleration on either 600 or 1200 volts operation. A hand-operated change-over switch, shown in Fig. 2, is used to change the main circuit over from 600 to 1200 volts or vice versa. On 1200 volts, the motors are operated four in series, and four in series parallel. On 600 volts, they are connected for operation with four in series parallel, and four in parallel. A dynamotor furnishes low voltage for supplying the lighting and control circuits.

The air brake equipment is of the Westinghouse "EL" type, and includes all apparatus necessary for the operation of the locomotive and train brakes. Air for the brake and

control systems is supplied by two D-3-EG dynamotor driven compressors, each having a delivery capacity of approximately 25 cu. ft. of free air per minute.

The performance of this locomotive is such that it will exert a tractive effort of 16,700 lb. at approximately 10:65 m.p.h. and, with a clean dry rail, a maximum tractive effort of 23,500 lb.

NEW PORTABLE METER TESTING LOAD RHEOSTATS.

Because of legislative rulings in many States, and because of the fact that meter testing at regular intervals is regarded as good business by progressive central stations, there has developed a need for light weight portable load rheostats for providing artificial load on the consumer's premises. Meter testing on the premises of the consumer is more convincing than tests made in the laboratory of the central station.

Improved Portable Rheostat.

The Cutler-Hammer Manufacturing Co. of Milwaukee have for some time been supplying portable load rheostats to a number of central stations and have now placed a complete line of bench type and floor type rheostats on the market. These load rheostats combine large capacity with convenient dimensions. They are suitable for both direct current and alternating current service, and for continuous duty. The line includes styles for service on 115 volts, 230 volts and 600 volt systems, as well as combination 115-230 volt rheostats. They are adapted for use with meters having the potential circuit across the outer wires, and also for those having the potential circuit across the neutral and one outer wire.

The resistance wire is wound on a light fireproof base and is covered with a special cement to prevent shifting or mechanical injury. The terminals are located so that there is no danger of making a mistake in connecting. The switches, mounted on asbestos lumber, are of the single pole type in which the blade is guided into the clip. For carrying, the feet are folded over the frame and held by a latch. The weight of the bench type shown in the above illustration is only 13 pounds.

ELECTRICAL EQUIPMENT FOR THE NEW YORK TRIBUNE.

The Sprague Electric Works of General Electric Company, New York, has been awarded the contract for furnishing and installing a complete electrical equipment in the new plant of the New York Tribune.

The apparatus will consist of the following:

One 200 kw., 125 volt, engine type generator; two 60 h.p. double motor equipments with full automatic push button control systems for operating Duplex newspaper presses; two electric hoists for handling paper rolls; various individual motors for operating stereotyping machinery. The present switchboard is to be remodelled with new instruments, switches, etc. Sprague conduit will also be used in the installation.

Thirty-two linotype machines in the composing department are already driven by Sprague electric motors and with the new additions to be made the plant will be a modern one in every respect. The Sprague Electric Works has long made a specialty of this class of installation and the Tribune outfit will be a striking example of what electricity is doing for the modern newspaper.

TRADE NOTES.

Fairbanks, Morse & Company have removed to their large new quarters at 649-651 Mission street.

The Erie Railroad Company has ordered from the Westinghouse Electric & Manufacturing Company two quadruple equipments of No. 132 Z motors and HB control.

The Westinghouse Electric & Manufacturing Company has received an order from the Springfield Street Railway Company, Springfield, Mass., for one double equipment of No. 307 A-2 motors and HL control, and one quadruple equipment of No. 323 motors and HL control.

Mr. S. G. Meek, who was appointed assistant general manager of the electrical department of the H. W. Johns-Manville Company, on May 15th, has been associated with the company as special representative in the electrical department for a period of over fifteen years, and has the honor of being one of the company's most successful salesmen.

The Holabird-Reynolds Company of San Francisco is being congratulated upon securing the coast agency of the Hughes Electric Manufacturing Company of Chicago, dealers in electric ranges. The attractive exhibit of the Hurley Machine Company at the Seattle Convention of the N. E. L. A. will be put on display in the San Francisco office of the Holabird-Reynolds Company.

An office has been opened at 817 Shreve Building by F. Harvey Searight, representing J. M. Main, Pacific Coast sales agent for the Skinner Engine Company, Erie, Pa.; Wilbain Bros. Boiler Manufacturing Company, Minneapolis; National Steam Pump Company, Upper Sandusky, O., and Union Iron Works (boilers), Erie, Pa.

The Pacific States Electric Company have taken the Pacific Coast agency for the steel towers manufactured by Hubbard & Company of Pittsburg. They have also taken the agency for the Union Metal Manufacturing Company of Canton, Ohio, on rolled steel ornamental street lighting posts; also the agency for Dodge & Zuill, of Syracuse, N. Y., manufacturers of the Easy Washer, a moderate priced electrically driven machine.

Reese Llewelyn, of the Llewelyn Iron Works of Los Angeles, is in San Francisco on business connected with a large contract for boilers awarded by the General Construction Company. It is understood that his firm will supply thirty-three boilers for the eleven oil-pumping stations to be installed along the new pipe line that is to be constructed for handling the output of the wells developed by the Esperanza Oil Company, and now controlled by the General Petroleum Company. David Dorward of San Francisco is the engineer for the oil interests.

NEW CATALOGUES.

The General Electric Company recently issued Bulletin No. 4910 which is devoted to Oil Break Switches for 600, 4500 and 7500 alternating current circuits. This is known as the Type F, Form K-5 switch, and is a switch of moderate rupturing capacity, liberally designed, conservatively rated, and simple in construction and operation. The bulletin enters into the details of construction, and contains dimension and connection diagrams.

NEWS NOTES

INCORPORATIONS.

SAN LUIS OBISPO, CAL.—San Miguel Interurban Telephone Company; $5000, subscribed, $4000; by T. H. Rouquet, W. M. Sutton, W. A. Wilmer, H. H. Durham and L. Van Horn

CITY OF MEXICO, MEX.—Mexican Midland Light & Power Company has recently been incorporated in Canada under the laws of the Province of Ontario to work concessions granted to Compania Hydro-Electricia Mexicano, S. A.

ASTORIA, ORE.—Artcles of incorporation of the Elk Creek Light & Power Company have been filed by Orrin Kellogg, Otto J. Kraemer and Lester W. Humphreys, with a capital stock of $5000 and principal place of business at Elk Creek.

ILLUMINATION.

ALBUQUERQUE, N. M.—Work on the new lighting system on Central avenue has been started.

SUISUN, CAL.—Bids for the sale of an electric power franchise will be received up to August 6.

SANTA ANA, CAL.—Henry Leukfield has asked the city trustees of Huntington Beach for a franchise to operate a gas plant.

SANTA PAULA, CAL.—The Sulphur Mountain Springs Company will install an electric light plant to furnish lights for cottages and tents.

SANTA MARIA, CAL.—The Lompoc Gas & Electric Company has applied for permission to purchase the plant of the Electric Light & Power Company for $50,000.

SAN JOSE, CAL.—Preliminary work has been started on the large substation for the Sierra and San Francisco Power Company, at Alviso, which will cost in the neighborhood of $25,000.

PHOENIX, ARIZ.—The power plant is owned by the city and it has been generating its own electricity, but now intends to put in transformers and get electricity from the government.

GARDNERVILLE, NEV.—The Douglas Milling & Power Company has made application for a franchise along certain public roads in Douglas County. The hearing of the petition will be held July 8th.

SAN FRANCISCO, CAL.—The only bid received by the Supervisors for lighting the streets, public buildings and places was presented by the Pacific Gas & Electric Company. The prices asked are the same as are now in effect for lighting, while a slight reduction is made on the electric power furnished the municipality. The company submitted five bids covering all classes of lighting and power service. The bid was referred to the Lighting and Rates Committee for consideration.

SAN FRANCISCO, CAL.—The reduction agreed on by the lighting rates committee of the Supervisors are: The price of gas, now 80c, is to be cut to 75c per 1000 cubic feet. The electric light rates, which are graded in accordance with the amount of current consumed, are trimmed so as to bring about an average reduction of 20 per cent. It is stated that approximately 4,000,000,000 cubic feet of gas may be used in this city during the coming fiscal year, although the consumption as reported by the gas company indicates that this estimate is somewhat t o high, and on this basis the saving to consumers will be about $200,000 for the year. The saving on electric light rates is estimated at $200,000 or more for the year. There is no reduction on arc lights, but on other lights the rate is reduced so that the maximum is reduced from 9c to 8c per kw. hour.

LOS ANGELES, CAL.—The Southern Counties Gas Company has petitioned the State Railroad Commission for authority to issue bonds to the amount of $443,000. They are the unsold portion of an issue of $1,000,000 dated April 1, 1911. The bonds carry 6 per cent and are to be sold at a price not less than 90. The corporation operates gas plants and distributing centers at Glendora, Azusa, Covina, Monrovia, Sierra Madre, Arcadia, South Santa Anita, El Monte, Whittier, Fullerton, Anaheim, Orange and Santa Ana. It proposes to extend its field of operations and purchase from the Southern California Edison Company for the price of $400,000 the gas plant and distributing system in Pomona and the pipe line and distributing systems in and adjacent to the towns of Claremont, Lordsburg and San Dimas. The company seeks permission to use the proceeds of its bond sale for the purchase of these properties.

TRANSMISSION.

SANTA BARBARA, CAL.—The Coalinga Water & Electric Company has applied for a franchise for the use of public roads for the distribution of electric power.

SNOHOMISH, ORE.—Jack S. Burton has accepted the position of construction engineer for an electric light and power system, including water power development, for Sultan City. The owners of the proposed system are I. C. Anderson, Frank and Herman Friese.

EUREKA, CAL.—It has just become known that H. M Byllesby of the Byllesby Company of Chicago, and one of the principal owners of the Western States Gas & Electric Company, is backing the Klamath River power project, which is destined to make Trinidad Bay an important harbor. A big electric smelter is to be erected at Trinidad and ores brought to that place from all parts of the globe will be smelted electrically. Preparations are now being made for the installation of the power station at Ishi Falls on the Klamath River.

SAN FRANCISCO, CAL.—Wires and conduits will have to be laid under five miles of streets by the Pacific Gas & Electric and City Electric Companies before January 1, 1914, if the ordinance proposed last week by the Supervisors' electricity committee is adopted by the board. The United Railroads will also be included in the ordinance, but have succeeded in obtaining a two weeks' continuance pending the return of General Manager Black. The section affecting the United Railroads will order all high-power feed wires placed underground in the new district specified. Overhead trolley wires and their appurtenances will be allowed to remain.

DAVIS, CAL.—The Pacific Gas & Electric Company is building an addition to its big new substation in this town to house two machines that will handle 4000 volts single phase electricity for the Southern Pacific Company's block signal system east and west of here. The railroad company has been using batteries to operate its block signals and the change to electricity from the new source is expected to work a saving and give better results. Poles are being set along the railroad to carry the "juice." The electric company is also building a power line east from Woodland to the substation that will supply power to the Vallejo Northern Railroad, the line being on the railroad's right of way.

LOS ANGELES, CAL.—E. F. Scattergood, chief electrical engineer of the aqueduct power bureau, submitted to the public service commission a report showing that the estimates

of cost for a complete and appropriate electrical distributing system for the city, which estimates were used as a basis for discussions at a recent meeting of the board, indicate that such a system as contemplated would cost the city $5,632,000. This system provides for all street lights, commercial lights and power within the present city limits as estimated for the year 1913. Scattergood's report contemplates an underground system, approximately one-third greater than the present underground area, and an overhead system for both street lights and commercial lights and power purposes throughout the remainder of the city.

MARSHFIELD, ORE.—What it is believed will be one of the greatest water powers in Oregon is to be developed in Coos County by Oregon capital at the cost of about $1,000,000. The plan is to build an enormous electric plant, the electricity to be generated by water power and to supply all of the towns of the county and rural and logging districts. The matter has been under consideration for some time and the men interested before leaving this city announced that they were gong ahead with the big project at once. According to the laws of the state they must have at least 12,500 horsepower developed by July 5, 1916, in order to hold the water right. The river has a drop of 1050 feet in one mile and by taking the water through the tunnel it will have a drop of 1600 feet. By increasing the height of the dam the power developed could be increased to 50,000 horsepower. The big drop of the water and the nature of the rock through which the tunneling must be makes the water right one of the easiest in the state to develop.

TRANSPORTATION.

RIVERSIDE, CAL.—Preliminary work on an electric line to connect Colton with Riverside by interurban trolley has begun.

EL PASO, TEX.—The contract offered by the local committee, providing for right of way and bonus of $15,000 of the El Paso-Ysleta interurban line has been accepted.

EUGENE, ORE.—A delegation of citizens from Pleasant Hill was in Eugene recently to urge upon the Oregon Electric officials that the road should build a line to Pleasant Hill. The officials seemed favorably disposed.

TUCSON, ARIZ.—Authorization for the expenditure of $90,000 in extensions and improvements of public utilities service, including street car lines, has been received by the Tucson Gas, Electric Light & Power Company.

YAKIMA CITY, WASH.—A movement has been set on foot by the commercial club of this city to have a bond issue voted for $3500, the money to be used as a bonus to build an electric line between this city and North Yakima, four miles distant.

PHOENIX, ARIZ.—Negotiations for the transfer of the Phoenix Electric Railroad Company system and franchise to the Salt River Valley Electric Railroad Company, which has been promoting the "White Line," are under way in Los Angeles.

HANKOW, CHINA.—A contract has been concluded between the government of China and E. K. Howe, representative of the Robert Dollar Company of Shanghai, for the construction of the new Hankow electric lines, including paving. The cost is estimated at $15,000,000 to $20,000,000.

SPOKANE, WASH.—It is reported that the Spokane & Inland, constituting the Hill eelctric system in Washington, contemplates rushing an extension from Colfax, to Pullman, electrifying the Northern Pacific from Pullman to Genesee, Idaho, and the construction of a line from Genesee to Lewiston. The sum of $1,500,000 will be requested for the work.

PORTLAND, ORE.—The Clackamas Improvement Association has made the suggestion to the Hill railroad interests that the railroad people construct an interurban line from Portland by way of the Reed college grounds up the valley to and through the Clackamas district, then on through a number of fine towns to the present line of the Southern Pacific Railway, and the watershed of the Cascade range.

STOCKTON, CAL.—The Tidewater & Southern Railroad expects to have its line completed between this city and Modesto by July 10, and will run an excursion from here. The trip will be made in borrowed coaches. The company expects to handle all of this year's grain crop along its line. Over 600 tons of steel rails are en route to this city for the company. The Western Pacific road has already brought five carloads of ties. The road is at present completed from Modesto to the Stanislaus River. The new material is believed to be sufficient to finish the road.

SAN FRANCISCO, CAL.—The public utilities committee of the Supervisors is undecided on the question of awarding the contract for the construction of the car house for the municipal railroad to F. Rolandi, the lowest bidder. Supervisor Murphy thinks that 10 per cent of the entire bond issue for the city railway is too much to spend for a car barn. Rolandi's bid is $210,000 for the least expensive of the three specified forms of building and $230,000 for the building with all proposed features. The latter offer is the one which is to be accepted if the contract is awarded.

SACRAMENTO, CAL.—The Railroad Commission has granted permission to the Sacramento & Woodland Railroad to construct its track at grade across the Southern Pacific rails at Mikon, Yolo County. It is directed in the order granting the application that the Sacramento & Woodland Railroad shall install at its own expense a first class standard, electric interlocking device with signals and equipment to make for the greatest degree of safety. The expense of maintaining and operating the interlocking device, after its installation, is to be divided, according to the terms of the order, between the Sacramento and Woodland and Southern Pacific Company.

SACRAMENTO, CAL. The Oakland & Antioch Railroad Company has filed an application for a franchise from the M street bridge on M to Third and on Third to I streets, with the City Trustees as a substitute for three applications previously filed. The term of the franchise asked is 49 years. The railroad proposes to build a double track along the route and a single track on the M street bridge for the purpose of carrying freight, mail, express and passengers. Work on the road is to be commenced four months after the franchise is granted and finished within a year. It is provided that the railroad must deliver the cars of any other interurban or steam railroad to any warehouse or wharf along its route and may charge a fee for such switching. The city is empowered to use any or all of the track for a belt line on condition that it pay a just share of the cost of construction and maintenance. No cars are to be permitted to stand on the streets. The road is to pay 5 per cent of its gross receipts to the city after the first five years.

TELEPHONE AND TELEGRAPH.

BLAINE, WASH.—It is probable that the Farmers' Mutual Telephone Company will make numerous improvements, including a $7500 central building, here.

SAN FRANCISCO, CAL.—Twin wireless stations to communicate direct with London will be built along the New Jersey coast, within a year, according to an announcement made today by the Marconi Wireless Telegraph Company of America. Options have been obtained on similar sites at San Francisco and Honolulu.

SAN FRANCISCO, CAL.—Before Railroad Commissioners Eshleman and Thelan Saturday, Hunt Chipley of New York, a special attorney for the Pacific Telephone & Telegraph Company, made a vigorous plea that the suit of the Tehama and Glenn counties telephone companies against his client for an interchange of switches under the provisions of the

public utilities act be dismissed. Chipley argued that no public convenience or necessity would be subserved by such a step, for the Pacific company was giving those sections of the State, as well as other parts of California, a modern, quick telephone service. The Commission denied the plea.

SAN FRANCISCO, CAL.—The ordinance presented by the Telephone and Rates Committee recommends the following changes from the rates now being collected: The complement of exchange switches included with the $5 per month rate is increased from 75 to 80 switches; the $7.50 per month rate is increased from 175 to 185 switches; the $9.15 per month rate is increased from 240 to 250 switches; the $12.47 rate per month is increased from 380 to 390 switches; the $15 per month rate is increased from 530 to 540 switches; the $17.48 per month rate is increased from 750 to 780 switches; the $19.57 per month rate is increased from 1080 to 1100 switches.

PHOENIX, ARIZ.—In all probability the Overland company will be taken over by the Mountain States Telephone Company, which last week acquired the Arizona Telephone Company. The negotiations for the purchase of the Overland nave been going on for a couple of weeks but nothing regarding them was disclosed until last week when it was learned that an agreement had been reached between a representative of the Mountains States company and a committee of the stockholders of the Overland. The company will accept a sum equal to 75c on the dollar for the bonds and 15c on the dollar for the stock of the Overland. This will bring the purchase price of the Overland to something less than $425,000. This proposition was accepted by Mr. Fennimore.

OAKLAND, CAL.—The City Council listened to Ernest Phillips, representing the League of Justice, give arguments for the reduction of telephone rates. Phillips read a communication from the Pacific Telephone & Telegraph Company asking that the present rates be unchanged. Maynard S. Bailey, manager of the Oakland branch, filed a statement from the company showing that the gross exchange revenue from the Oakland plant for 1911 was $682,725.39 and that this amount was upon an investment of $3,163,000, showing an actual return on the investment in Oakland of only 2½ per cent after payment of operation expenses, depreciation, etc. Stock in the amount of $32,000,000 preferred and $18,000,000 common has been issued, it was claimed for the company, representing an actual investment upon the entire plant from Canada to Mexico. The company has been paying 6 per cent dividends on preferred stock and nothing on common stock. It was pointed out that Oakland was enjoying the lowest rates for the same number of subscribers on one exchange of any city in which the company operated a plant. It was hinted by officials of the company, in the event of the Council fixing a lower rate than now charged, the matter would be taken to the courts.

WATERWORKS.

LOS ANGELES, CAL.—The Utlities Company has applied for permission to issue $10,000,000 bonds. The company's headquarters are in Riverside, and it proposes to supply water for a tract of 30,000 acres in that county.

ASTORIA, ORE.—The water commission at Seaside will begin work immediately on the construction of a new water system for that town, and will make improvements that will entail the expenditure of approximately $15,000 this summer.

MILL VALLEY, CAL.—A general election of the Marin municipal water district will be held in the county of Marin June 27th, for the incorporation and organization and management of a municipal water district and to provide for the acquisition and construction of said district of water works.

PORTLAND, ORE.—Work will be started immediately on the big pipe line which will connect the new $3,000,000 gas plant of the Portland Gas & Coke Company at Linnton with the distributing tank at the foot of Glisan street according to an announcement made by Guy Talbot, president of the company. The high pressure main will be six miles long and 16 inches in diameter. The cost is estimated at $100,000. The company will expend about $600,000 in addition during the next six months on the first unit of the gas plant at Linnton.

RAYMOND, WASH.—City Engineer Henry has reported plans and estimates for two water tanks to be used as an auxiliary to the salt water fire protection system. The plans submitted call for two tanks with a combined capacity of 100,000 gallons. Tanks to be 22 feet square and 14 feet deep and their estimated cost is $300 each. With the necessary pipe connections, with salt water mains, etc. The total cost is estimated at about $2600. The Council instructed the city clerk to advertise for bids for the construction of the tanks.

OAKLAND, CAL.—That the present water rate, without the injunctional 15 per cent, gives the Spring Valley Water Company a fair return on its investment and should be made the official rate for the ensuing year is the decision of the majority of the committee of the whole of the Supervisors. The committee's action was largely influenced by the report of the water company, which shows that its profits last year amounted to $1,300,000, which is equivalent to 6 per cent. The committee takes the position that this statement of the company justifies the rate now in existence. It also shows that the profits of the company are steadily increasing, so that the return for the ensuing year on this rate would doubtless amount to $1,500,000 and amply justify its fairness if tested in court.

SACRAMENTO, CAL.—The proposition of the Sacramento-Sierra Water & Power Company to furnish the city with a clear mountain water supply is said to admit of the possibility of developing electric power for municipal use. The Sacramento-Sierra Company plans to get its supply of water from the Volcano reservoir between the watersheds of the Cosumnes and Mokelumne Rivers in Amador County. It is proposed to pipe it to Sacramento, where it will be delivered at a pressure of 85 pounds at the rate of two million gallons a day. The company is willing to enter into a 50-year contract with the city, the latter reserving the privilege of purchasing at any time for $2,500,000. The officers of the water company are: Edward Records, president, San Francisco; Dr. Dudley Smith, vice-president; John Muldoon, treasurer, Berkeley; Chas. L. Barsotti, secretary, San Anselmo; C. J. Lancaster, Alameda; E. D. Boydston, superintendent, Volcano; George P. Robinson, manager, Sacramento.

SAN FRANCISCO, CAL.—The Southern California Utilities Company has applied to the Railroad Commission for permission to issue bonds in the sum of $10,000,000. The company has its headquarters in Riverside and proposes to sell water for purposes of irrigation. The application states specifically that it is intended to supply water for a tract of 30,000 acres in Riverside County. The company states that it has options on the properties of the Ramona Power & Irrigation Company, the Lake Hemet Water Company, the Fairview Land & Water Company, the Hemet Land Company and the Hemet Town Water Company. From the proceeds of the bond sale, according to its petition, the company proposes to expend $4,700,000 in new construction in developing the Ramona Power & Irrigation Company. A portion of the balance will be utilized in the purchase of the other companies. The project will be financed through the Universal Construction & Investment Company.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII — SAN FRANCISCO, JUNE 29, 1912 — NUMBER 26

OUTDOOR SUBSTATIONS IN SAN JOAQUIN VALLEY

BY RUDOLPH W. VAN NORDEN.
Member A. I. E. E., A. S. C. E.

The problem of a distribution of power, where the area covered is large, the individual power units small and widely separated, with the possibility of low load factors, is a problem in the utmost economy of design and construction in order that such a business, even where there is no competition, may be a commercial success. Where economies can be obtained and at the same time maintain the class of service necessary to uphold the business, these savings in first cost are of equal benefit to the company furnishing the power and the commonwealth which may be benefited through the availability to get power.

Natural conditions in the San Joaquin valley are such that a radical economy has been successfully experimented with by the San Joaquin Light & Power Corporation—the adoption of the so-called out-door substation.

The substations of this company are widely separated over a great area of country and in many cases are at remote points. The substations are invariably transformer stations, many of them transforming down from 60,000 volts. Following standard practice, a number of these stations have been erected, the entire equipment being contained in steel and concrete fireproof buildings. The danger of fire from various causes which is always more or less present in such an installation, forms a risk which, while compensated to some extent by non-inflammable structure, neces-

Raising of Intensive Crops in San Joaquin Valley Causing Demand for Numerous Substations

sitates the constant attention of a watchman or attendant. Both the first cost of first class building construction and the wages of the attendant add a serious operating and interest charge to the investment of which the distribution from the particular substation may be considered to represent.

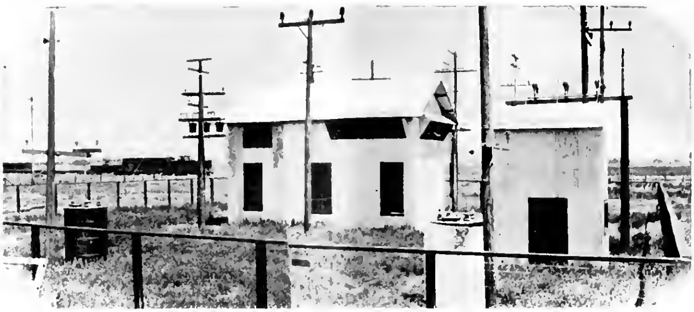
It has been with the idea of eliminating a portion of the fixed charges by reducing the first cost of structure and the cost of regular attendance, and incidentally the risk of the damage caused by fire to adjoining apparatus, that the out-door substation has been developed.

The ideal condition, where high-tension apparatus, transformers, and low-tension apparatus might be so separated that a fire or accident to one part would by no possibility be communicated to the others, might not be an economical possibility; but this has been approached and the results have not only proven the wisdom of the system, but have developed at least one advantage not looked for.

The Los Banos substation about to be described is similar to two others, one near Mendota and another under construction at the edge of the Sierra foothills, near the Kings River. All are designed to operate in connection with 60,000 volt transmission feeders, although at present a lower voltage is being supplied.

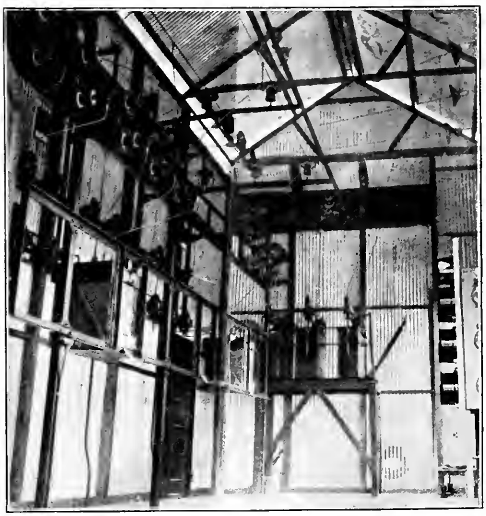
At Los Banos a plot of ground 100 x 150 ft. is enclosed with a 7 ft. rabbit-proof galvanized wire farm fence and in this enclosure are three 125 kw. transformers, a small building containing the lightning arresters, a building containing the oil circuit-breaker and instruments, a small storehouse for materials and a storage yard.

The high tension leads are carried through 60,000 volt wall insulators, mounted in 1/4 in. steel panel plates, to the time limit oil circuit-breaker within the building, the transformer lead passing out of the building in a similar manner to a pole from whence the lines are distributed to the three transformers. These are ranged along one side of the enclosure and placed about 50 ft. apart. Directly behind each transformer is a pole which carries one insulator on top; to this is brought the high tension lead for that transformer (star connection being used) and a line is dropped to the transformer terminal. The transformer is oil immersed and air cooled, there being supposedly no water available for cooling. In the case illustrated the transformer tank has wrought-iron fins to increase the cooling surface. A concrete base or tablet raises the transformer slightly above the ground surface and gives room to draw off the oil if necessary. These substations are in a country where excessive summer temperatures are experienced for extended periods and the transformers themselves, being in the open, are exposed to the direct rays of the sun from sunrise to sunset. It was at first thought that the heat which they would absorb would make operation at a safe temperature a difficult matter. It has been found however that the transformers being subject to every movement of air actually remain cooler than would



The Los Banos Outdoor Substation and Lightning Arrester Building.

be the case if they were enclosed with a building, even supposing it to be well ventilated. An experiment of encasing the transformer in a sheet iron shell, painted white to reflect heat, was made (shown in foreground of view) with the two-fold idea that the tank itself would not get the direct rays of the sun



Interior View Los Banos Substation.

and also that a flue would be formed to cause cooler air from the ground to rise between the tank and casing thus causing a continuous cooling draft. It was found that the transformer actually operated on an average of 5 degrees F. cooler without this casing that with it. The top and terminal bushings for the transformers are of course made weatherproof.

The high tension line is brought on to the property at any convenient point, the last pole containing pole-top disconnecting switches. Taps are taken off which lead to horn gaps mounted at a pole-top fixture and near these is a small house of galvanized corrugated iron on a simple timber frame, occupying a ground space 5 ft. x 7 ft., with a total height of 14 ft. This contains the electrolytic aluminum cell lightning arresters.

The low-tension leads from the transformers are brought to a crossarm on a pole suitably placed and then carried to the switchhouse.

The switch building is 30 ft. long, 15 ft. wide and 18 ft. high to the eaves and is of similar construction and material to the lightning-arrester house. The floor is of concrete and all switches and wiring contained therein are mounted on a standard type of structural steel framework developed by this company. This frame carries a bus line mounted on standard 10,000 volt porcelain insulators along the top, and to this is brought the secondary circuit from the transformers. This frame is of a standard design which, by building to the proper length will accommodate any desired number of switches and outgoing circuits. The accompanying illustration shows the mounting of the 3-pole 10,000 volt oil switches. Opposite these is a one-panel marble instrument-board; the switch control, for the sake of simplicity being at each individual switch. The panel contains, 4 ammeters, 1 indicating and 1 recording wattmeter and in the rear, on one side of the supporting frame are 12 single phase integrating wattmeters. Meter transformers are mounted on a pole outside and their secondaries are brought to the instruments through iron pipe conduit.

Provision is made for four outgoing 10,000 volt circuits, although but three are now installed.

There is one General Electric 10 kw. 6.6 ampere arc transformer with panel and switch (not shown in cut) for street lighting in Los Banos. This circuit is automatically controlled by a standard time switch. The company's regular telephone equipment is provided.

Save for occasional inspection, telephoning, or switching operations, this station remains locked and requires no regular attendance.

Labor and material, buildings and foundations....	$ 944.72
Labor and material, oil switches, instruments, wiring, inside equipment	2,706.5[illegible]
Labor and material, installing transformers, outside wiring and lightning arresters, but not including the cost of the transformers	1,511.[illegible]
Total cost of installation	$5,162.[illegible]

INTERNATIONAL CONFERENCE ON RADIO-TELEGRAPHY.

An International Conference on Radiotelegraphy, at which all the countries of the world are represented, except those having no seaboard, assembled in London on June 4, and is expected to last for four weeks. There are about 150 delegates. This is the third international conference that has taken place on the subject of wireless telegraphy, the first being a preliminary and the second a formal conference, held at Berlin in 1906. The third conference was to have been held last year, but was postponed until 1912.

STENOGRAPHIC REPORT OF SAN FRANCISCO SECTION OF A. I. E. E.

The papers of the evening were by Mr. J. S. Hobson, on Railway Signaling; by Mr. P. J. Ost on Electric Interlocking in Railway Signaling, and by Mr. J. B. Struble, on the Employment of the Alternating Current in Railway Signaling.

At the conclusion of the reading of the papers, some stereopticon views were exhibited, and the following discussion had:

A. H. Babcock: Obviously it is impossible for anyone of us to do more than express appreciation of papers such as have been given by those who are distinctly recognized in the signaling art as at the head of the art. Anything else would be a good deal like telling artists how to paint a picture, because these gentlemen are so expert, and have gone into the details of the manufacture to such an extent, that it seems to me that possibly a few words on the subject from the railroad man's standpoint may be appropriate here.

Mr. Struble referred to someone who went East in 1901 to buy a signaling system without knowing what he was going after. I was the victim. I fell into the hands of Mr. Struble first; but before I met him I was fortunate in running into an old friend who gave me very concisely the essentials that must be found in any adequate signaling system of a railroad that is dignified by that name. They were briefly these: The system must be such that the mere presence of a pair of wheels and an axle on the track, or a broken rail, or a misplaced switch point, must inevitably cause a stop signal to be displayed. Now anything short of that is merely a makeshift. Consequently, when our electric railroads start in to count cars into a block or out of a block, they are committing not only an engineering folly but a business folly, the price of which is damage to persons and property caused by the use of such things.

Only the other night I sat in an electric car on a siding with a signal displayed to prevent us leaving that siding. I could see a car coming down the hill, and knowing the nature of the signaling apparatus I waited to see what was about to happen, particularly as I could see the headlight of a second car following the first. When the first car came in and passed us on the main line, we being on the siding, the signal that was to stop us from proceeding cleared, and gave us a clear signal to go ahead, although there was a car in sight coming down. That is merely an example of the counting in and counting out method. There was a miscount and a single track road.

Now, Mr. Hobson referred to an interlocking episode, in which he said that, having once lined up a route it was impossible to change that route for a given length of time, that provision being put into the system to prevent a signal man accidentally throwing a switch after he had lined up a certain route to change that route in face of an oncoming train. That was an embarrassing situation once on the North Shore road, when a man disregarded all signals and got the trains together, the towerman in sight of both trains helpless because he could not change that signal switch. What was needed then was not an adequate signal, but some means of automatically stopping the trains to prevent the consequences of a disregard by the engineer of a very plain indication to stop his train. As my own chief once remarked, what we needed was not a device to tell an engineer to stop, but something that when he didn't stop would take him by the slack of the pants and throw him over the railway fence There is a good deal of common sense in that. I myself came out of New York City at the head end of an electrically operated train on the New Haven line, and that engineer disregarded deliberately every signal that he came to except those within the Park Avenue tunnel. In other words, immediately he left the Park Avenue tunnel he followed a train immediately preceding us. That sort of situation is quite ordinary. I think the checking on any railroad will show

that many times our engineers and motormen do absolutely disregard indications, and they run on their sight of something else. That has led to the development of the automatic stop device, whereby the train pipe is bent whenever an engineer attempts to run by a signal that is set against him. That device is objected to very strongly on the part of some of the older steam road men, on the ground that to make complete protection you must provide every locomotive and car in the system with this stop device. To me that argument is not at all valid, for the simple reason that every vehicle on the track so protected is simply one step toward the total protection that we all would like to see, so that having spent money on your own equipment you have protected yourself just to that extent.

I think the lesson in this evening's talk to us electrical men is to prove that we should not be led away by specious advertising that guarantees us a protection that does not protect. If our railroad system is at all of the kind that demands any protection, it seems to me business folly to stop short of the total protection; and I can not see the practical common sense in buying any cheap counting in and counting out system. I see only one thing to be done, either to leave is out entirely, or go to the best, namely, the alternating track circuit.

T. E. Bibbins: I would like to ask if any recent development has been made in the graded signal, with the object of making it possible to run closer than ordinary block?

J. B. Struble: In connection with the general question I would say that a system has been developed by which trains in approaching stations may close up upon each other, so that the interval during which no train is present at the station platform for loading or unloading passengers is cut down to a very small space of time.

These closing in signals are operated on the time principle, in which a following train, that is, a train following another one which is at the station, stops at a signal which is held in the danger position some distance in the rear or the approaching side of it, for a certain length of time, until a pendulum operated circuit controller working by an escapement closes a circuit, which cuts out a certain track circuit, thereby permitting the train to close up another block length, which block is very short.

The ideal system would be that in which signals move along the tracks a safe distance behind a train; by putting more and more signals along the track at short intervals, we approach what would be such a system. A system like that means an overlap, by which each signal is controlled by a certain length of track circuit; and by that means there may be half a dozen signals or more showing stop, at the rear of a train. On the Brooklyn bridge there is such a scheme, in which I think there are as many as seven overlaps at any cross-section of the road, or at certain cross-sections of the road. That means that a train will hold seven signals at stop in the rear of it, so that one train following another does not have to wait until the preceding one has gone a long distance. In other words, trains move along at fixed intervals. I judge that is what you referred to.

T. E. Bibbins: Yes, the overlapping system. Has that graded system been perfectly satisfactory?

J. B. Struble: Yes. I don't recall any accidents having occurred in connection with it. It is working very successfully. In fact the matter of time in the Interborough system is figured in seconds. The delay of a train is figured in seconds. A delay of one second per train stop means quite a difference in the number of passengers that can be carried. I got this from a friend, who has the data pretty accurately.

A. G. Jones: I would like to ask Mr. Struble if the alternating current system, where you see the induction motor for operating the signal, if you ever have any trouble due to short circuits in the field winding of the 60 cycle motor, which would, if used on a 25 cycle propulsion, be apt to give false signals?

J. B. Struble: A failure of any part of the induction motor for operating the signal could not cause a false signal, under the conditions stated, or otherwise for that matter.

J. R. Bibbins: I might mention a case in regard to the graded signal. My chief, Mr. Arnold, was quite instrumental in bringing that graded signal to the front in the Interborough Subway, and the problem there was to increase the capacity of the bore. Now they are absolutely up against it. The subway was designed for a certain capacity, and has gone beyond it, and there seemed to be no hope, and as the situation existed then there wasn't very much encouragement toward increasing the capacity, and this graded signal was the result. It only shows that as the result of detailed technical study very often we can transgress the bounds of propriety, so to speak.

A. H. Babcock: I would like to ask Mr. Bibbons, if there is any difference between that situation, that is, to increase the potentiality of the subway, and the usual system of signals controlled by overlaps in one direction? In other words, is it not the ordinary automatic block system with the blocks shortened and more distant signals controlled by one home signal? Isn't it essentially that?

J. R. Bibbins: I must confess I am not a signal expert. I only know the results did occur in New York after a very much needed discussion.

A. H. Babcock: My point is, it is not a new device, but merely the application of well known methods applied intelligently to a particular problem. Is not that so?—the shortening up of the headway of the train on approaching stations?

....**J. S. Hobson:** It is used to quite an extent on the Pennsylvania. A train at any given track section has two blocks of danger behind it for the home and distant signal, and the distant signal only at the third block. The automatic stop between blocks is clear when the second block behind the train is stopped.

A. H. Babcock: It is the same thing that has been used before, only the blocks are shortened and more distant signals.

J. S. Hobson: They have extended the overlap the entire block.

S. B. Charters: Is there any further discussion coming up? If not, I might say in closing that I have had one experience with a counting in and counting out signal, in which an electric car was intended to operate a crossing bell by counting in and counting out; and it worked successfully for a day or two, and after that it happened that once or twice as the last car went down at night the signal refused to drop, and the bell rang from 11 o'clock at night to 7 o'clock next morning, which was rather harassing to the neighborhood. The result was that after two or three experiences of that kind, one night some vandals destroyed the signal, and its usefulness ceased.

Thereupon the meeting adjourned.

APPLICATION FOR ONE MILLION ELECTRIC LIGHTS AT TOKYO.

The Japanese Government has rejected the application of the municipal authorities of Tokyo for permission to increase the capacity of the electric light department of the city to approximately one million lights. The municipality of Tokyo is now engaged in the lighting business through the ownership of the electrical street railway lines. The Tokyo Asahi states that the reason for rejecting the application is that when the establishment of the Nippon Electric Light Company came up for approval last year, the government, after investigation, ascertained that there was ample room for the operations of three companies

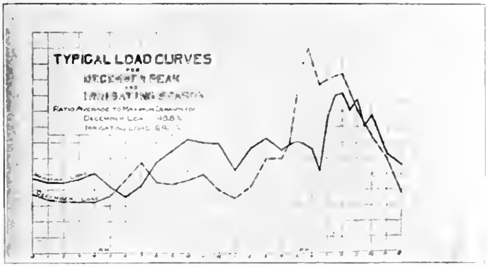
USE OF ELECTRICITY FOR IRRIGATION AND ON THE FARM.[1]

BY C. H. WILLIAMS.

The application of electric power for irrigation pumping requires a knowledge of irrigation engineering, and as irrigation engineering is a product of the present generation, a discussion of electric pumping will be more comprehensive when prefaced by a few statements concerning irrigation work in general.

Two kinds of irrigation are in use: The ordinary gravity flow, such as that of taking water from a reservoir and ditch, and the mechanical lift, such as pumping water from a well, and of the two, the development of the mechanical lift is far more rapid.

In any country where the annual precipitation averages less than twenty inches, agriculture cannot be carried on successfully without resorting to some means of supplying water artificially to the land.



The Effect of Irrigation Pumping on Power-House Load Curve.

There are three hundred million acres of such lands lying immediately east of the Rocky Mountains and between the limits of Canada and Mexico, and these lands presents one of the greatest problems ever found in the development of agriculture. The area is tremendous, the soil is deep and fertile, the climate is healthful and agreeable and all conditions are ideal, except for the lack of moisture. Of this territory, the states of Colorado and Wyoming occupy the richest part. For a distance of one hundred miles from the mountains toward the east, the precipitation will average, but fourteen inches, while in the mountains it is greater. Winds heavy with moisture are brought in contact with the colder mountain peaks and precipitate it largely in the form of snow.

However, Nature has provided that this limited amount of precipitation is so distributed that it does the greatest amount of good. Accurate reports on the Cache La Poudre River basin, a representative irrigation stream in Colorado, show that 55 per cent of all the rainfall on the plains falls during the growing season. In the mountains, where practically all of the irrigation rivers have their source, the conditions are reversed, and the greater portion falls between October 1 and the last of April. These winter snows lie as storage in the mountains until melted late in the summer and then run down and supplement the rainfall on the plains when water is most needed. The importance of this to irrigation is apparent from the statement that 82.5 per cent of all the precipitation on this watershed is available on the plains, either as rainfall or as stream flow, during the short growing season between the first of May and the last of September.

Underflow.

Other waters are available than those found in the surface streams. Engineers' reports show that only one-half of the precipitation in the hills is accounted for in stream flow, and it is a natural question to ask what becomes of the vast quantity unaccounted for. This seeps into the ground, finds passage below the surface soil and gradually travels eastward and may appear as springs along the Mississippi Valley. Below the surface of the plains are strata formed of different materials, such as sand, gravel, clay, shale and rock, through which the water passes at velocities dependent on the compactness of the beds. In loose sand and gravel, the water finds a freer passage than in clay or rocks, and large quantities are available where these strata can be found and intercepted.

The waters which pass down the streams and are diverted through the ditches or into reservoirs and then through ditches to the fields add further quanties through seepage losses, to increase the underground supply.

This seepage action is pronounced and the system of irrigation in the arid West has raised the water table by a gradual increase of this ground supply, and in Colorado has amounted to a rise of from 20 to 40 feet, and even more in places where irrigation has been carried on extensively.

A practical demonstration of the fact was shown by the action of a 28-ft. irrigation well put down some years ago near Greeley, where the first colony of white men settled in Colorado in 1870 on the Cache La Poudre River. A good flow of water was encountered when the well was sunk and a considerable acreage was irrigated without diminishing the supply. Later, ditches were built and the surface water in the well began to rise, and this continued with the ditch development. The water has now risen and stands within three feet of the surface, and since the installation of a motor-driven pump, the well delivers a flow of 200 inches of water day and night without diminishing, and it irrigates an entire section of farm lands. This well is a large producer for its type and the question is often asked as to how much irrigating can be done from this underground supply.

In California, over 10,000 irrigation wells have been put down and 135,000 h.p. is made use of for lifting the water which irrigates 300,000 acres.

It is evident that the underground waters attacked by sufficient pumping-plant capacity, with no replenishment, would be depleted, but the storage that is there today would water a tremendous acreage. The actual loss of water through pumping consists only of that which gets away through the limited evaporation from the field, through absorption by entering into plant life, and by the seepage to strata beyond reach, while the factors which add to supply are the seepage losses from the ditch and reservoirs and field, the rainfall which soaks into the ground, and the large underground supply from mountain sources.

It is necessary to use all the supply available, and in many sections of the country the most practical

[1]Abstract of a paper read before the Seattle Convention of N. E. L. A.

means of adding to the irrigated section is by the raising of underground waters to the surface. It is plainly evident that if this water can be pumped and run upon the field, the efficiency of the water can be increased tremendously by each separate pumping operation, and in this second duty, the heavy losses which occur, as in canals and ditches, would not be present and the only actual loss would be that from evaporation and the actual composition in the plant.

So long as abundant water was supplied to fill all needs no one was interested in the losses, and as the early appropriators measured the water at the headgates, if at all, an erroneous idea of the amount of water actually required on the field has been established. This error has been so firmly fixed in the mind of the farmer that one of the greatest difficulties experienced in introducing pumping plants is proving that the large amount of water turned in at the headgates delivers no more water on the land than the comparatively small amount lifted by the pump.

Duty of Water.

The quantity of water required varies with different crops, and in planning a pumping plant it is necessary to know the quantity of water required by all the crops which may be raised, as it has been found to be of great advantage to rotate crops; that is, to change the crop from year to year and to follow certain rules wherein one crop follows another to advantage. Authorities differ somewhat as to the amount of water different crops require. John H. Gordon, who has charge of the Government Experimental Farm at Cheyenne, Wyoming, and who is recognized as an authority and a practical farmer, says that from three-quarters to one acre-foot of water in excess of the 14 inches rainfall there received, if properly applied, is ample for a bumper crop of alfalfa, grain or beets, and he refers to irrigation at an elevation of over 6000 feet, and where abnormally high winds prevail; and he proves his statements by producing bumper crops.

Irrigation Substation in California.

Vineyard Irrigated by Electrically Pumped Water.

Measurement of Water.

The water-users speak of quantities in different terms. The farmer usually refers to the quantity of water measured in inches, meaning the statutory miner's inch. In Colorado the miner's inch is the volume of water which will flow through a one-inch orifice under a five-inch head, where the head is measured from the top of the orifice to the surface of the water. The irrigation companies measure in second-feet, and the number of second-feet is determined by the number of cubic feet passing a given point in one second's time. A miner's inch is equal to 11¼ gallons in a minute and 38.4 inches equals one second-foot.

In pumping work, the rating of a pump is used, based on the number of gallons delivered in a minute of time, and amounts of water are often given in acre-feet, which means the area of one acre covered with water one foot deep, or 43,560 cubic feet. One cubic foot per second flowing for 24 hours steadily will deliver practically two acre-feet. An acre-foot of water raised through the distance of one foot requires theoretically 1⅜ h.p.-hrs., and as 50 per cent is the ultimate efficiency of an average motor-driven pumping plant under heads of from 15 to 50 feet, a rough figure for calculating the energy required is 2 kw.-hrs., consumption per foot-acre-foot, or per acre-foot of water lifted one foot high.

Cost of Pumping Plant.

The cost of the typical pumping plant complete for which the farmer makes an investment for supplying water to a 160-acre tract, is as follows:

Excavation of well-pit 12 ft. deep, 12 ft. diameter and excavation for two suctions 25 ft. from center of the well	$ 55.00
Three 12-inch slotted casings of No. 16 gauge, each 30 ft. length, installed	180.00
Concrete linings	42.00
No. 7 horizontal centrifugal pump with capacity of 1200 gallons per minute	225.00
15-hp. motor, 2300-volt, 60-cycle, 3-phase, 1200 r.p.m., installed	325.00
Wiring, switchboard panel, including switching and protective devices	52.00
Piping, three suctions, discharge gate valve, priming pump, discharge piping	137.00
Housing built of concrete complete	115.00
Incidentals	25.00
Total investment	$1156.00
Investment for completed plant per acre	$7.23

Cost of Pumped vs. Ditch and Reservoir Water.

To show an absolute comparison between the cost of water pumped and water served by a gravity system, figures are taken from northern Colorado, where old-established ditches are serving large acreages of lands and electric motor-driven pumping plants are lifting irrigation water for 20,000 acres.

The market values of Ditch and Reservoir Rights as of the spring of 1912 are given by the officers of the companies as follows:

NO. 2, OR OLD COLONY DITCH.

Cost of ditch water for 160 acres	$[illegible]
Cost of reservoir water for 160 acres	[illegible]
	$9000.00

LARIMER AND WELD, OR EATON DITCH.

Cost of ditch water for 160 acres	$[illegible]
Cost of reservoir water for 160 acres	[illegible]
	$7200.00

WATER SUPPLY AND STORAGE DITCH.

Cost of ditch water for 160 acres	
Ditch and reservoir water construction	
	$6400.00

These rights as quoted are on the basis of water for 160 acres, and the farmer pays outright an average of $7,533.33 for his perpetual rights to this amount of water, and also as an expense for water he must figure an annual interest charge on his investment, at the prevailing rate of interest in his territory, which is 8 per cent, for he could loan the $7,533.33 at 8 per cent on good farm lands, if the money were not invested in these water rights.

The $7,533.33 per 160-acre right, equal to $47.20 per acre, is, however, not enough to take care of the investment made by the companies, as the ditch and reservoir companies have interest charges to meet on very large bond issues covering the whole development, hence an assessment is made against the shareholders to cover the interest charge, and this for the past three years has amounted to $1.68 per acre. A further assessment or charge is made against the shareholders for the annual upkeep of the property, this last amounting to an equivalent of 40 cents per acre.

The actual cost, then, to the farmer for his water, as compared with a similar cost for pumping, is

	Per acre
8 per cent Interest on original investment of $47.20	$[illegible]
Assessment on account bond interest, etc.	[illegible]
Maintenance cost	[illegible]
Total actual cost for water per season	$[illegible]

This assessment for the payment of bond interest has been found to be inadequate in many cases to take care of the obligations to be met, and in casting up the prospects for the future it is seen that this assessment will have to be materially increased, or the companies will find a greatly enlarged obligation at the end of a period of years.

The total cost of pumping water is much less than its cost from ditch and reservoir. For a pumping plant, the farmer also makes an investment, and here not only is the interest figured in, but 3 per cent is added for depreciation. The average investment in a pumping plant, including cost of well, cost of motor, pump, housing, wiring, piping and the plant complete, is $7.23 per acre, as shown in detail earlier.

The average lift on 90 pumping plants supplying irrigation in the territory is 23 feet. The average efficiency of motor and pump is 50 per cent. The average amount of water supplied to the field per year is [illegible] acre-foot.

The interest charge is figured the same in either case, at 8 per cent, which, with the added fixed charge of 3 per cent depreciation, gives a total of 11 per cent.

11 per cent on $7.23 equals	.80 per acre
$\frac{43{,}560 \times 2 \times 62.5 \times 23 \times .764 \times .03}{1{,}980{,}000}$	1.40
	2.20 per acre
Oil, waste, maintenance and attendance	.27 per acre
Total cost, including interest, depreciation and all operating costs	2.47 per acre

as against $5.85 from ditch and reservoir.

The gravity water costs practically twice as much as the pumped water under these conditions.

One manager of a large sugar factory states that he can afford to incur an expense of from $8.00 to $12 per acre per season for water in raising sugar beets, and he is now putting in a large number of deep wells to irrigate 37,000 acres of beet land.

Cost of Raising Different Crops.

The actual amount of money which can be expended profitably for water depends largely on the value of the crops which can be raised. The government has published figures on the cost of raising certain crops and these have been corrected to Colorado conditions by the best posted men in Colorado.

SUGAR BEETS.

Revenue based on a yield of 13.5 tons per acre at $5.50 per ton		$74.25
All expenses		
Plowing 9-in. deep	$ 2.00 per acre	
Preparing seed bed	1.50	
Planting	50	
Seed, 15 lbs. at 10 cents per lb.	1.50	
Rolling	50	
Cultivating 4 or 5 times	2.50	
Bunching and thinning	7.00	
Hoeing 2 or 3 times	2.00	
Plowing out beets	3.00	
Topping and piling	9.00	
Siloing 25 per cent of crop	1.70	
Depreciation on machinery	1.00	
Hauling 3 miles	8.50	
Interest on investment	16.00	56.70
Balance which could be paid for water		$17.55

POTATOES IN GREELEY DISTRICT.

Revenue based on yield of 100 sacks at .725		$72.50
Expenses		
Plowing	$ 2.00	
Harrowing	50	
Planting	1.50	
Seeding	9.00	
Cultivating	1.50	
Sacks	7.50	
Harvesting	8.00	
Marketing	6.00	
Interest, 8 per cent on $200	16.00	52.00
Balance which could be paid for water per acre		$20.50

Summary.

From the viewpoint of the farmer, the introduction of electricity into farm methods reduces the cost of production of farm products. The chief saving is in labor and the ability to apply scientific and systematic methods to the industry.

From the central station viewpoint, it means an off peak load, a high kilowatt-hour current consumption and a satisfied customer.

ELECTRIC STEAM GENERATION.

That a tubular steam boiler may be operated without any fire, the water in each tube being heated by an electric element contained within the tube itself, has now been amply demonstrated. Expense will probably prevent the use of such boilers for motive power, but there are conditions in which they will be valuable. They are in use, for instance, in generating steam for heating trains drawn by electric engines. One might think that it would be more economical to use the electric current directly for the heating; so it would where electric power is to be used to operate the train throughout its course. In many cases, however, an electric engine is used only within city limits or within a definite zone, and steam must be used for heating after it is uncoupled. Here, therefore, the electrically-heated steam boilers come usefully into play.

EARLY DAYS OF EDISON

BY JAMES A. LIGHTHIPE[1]

The celebration of Mr. Edison's 65th birthday by the "Old Guard," at Llewellyn Park, Orange, New Jersey, on January 11, 1912, brought before many of us the vivid picture of Mr. Edison in the days when the knowledge of electricity was young, and when its wide application to the service of man was undreamed of.

In the year 1879 Thomas A. Edison reached the pinnacle of his fame. He had a well equipped laboratory and machine shop in Menlo Park, New Jersey, and employed some forty or fifty men. He had already invented the quadruplex telegraph, the carbon transmitter which made the telephone a success, and the wonderful talking machine which he had named the phonograph; and the phonograph more than any

James A. Lighthipe.

one thing that he ever invented probably made him famous and gave him the newspaper title of "The Wizard of Menlo Park."

Mr. Edison had been experimenting for a year or more with the problem of subdividing the electric current so that it could be used in the household, to take the place of illuminating gas. His idea was to make a small lamp enclosed in a sphere of glass so that the filament used would become incandescent from the flow of current through it. After working almost two years on various metals, principally platinum covered with numerous oxides to increase the illumination, with very delicate thermostats contained therein to cut off the current in time to prevent the platinum from reaching a temperature where it would melt, he finally started experimenting with small filaments of carbon, using pieces of thread, card board, thin slivers of wood, etc., and the results were so promising that he started a long series of experiments to determine what form of fibre would be strongest after it was carbonized. Mr. Edison did most of his experimenting at night. This was due to the fact that it being close to the large cities, New York and Philadelphia, there was a constant succession of visitors who would insist on going through the laboratory. He usually wore an old suit of clothes, with a red bandana handkerchief around his neck, and an old straw hat without any brim. Frequently some stranger would accost him with the request to tell them if he knew the whereabouts of Mr. Edison. He invariably directed them in some other direction and went on with his work. It took several hours to make a new filament, fastening the filament into the lamp with a small clamp and screws as minute as those used in watch making, have the glass blower enclose the filament in a glass bulb, and then Mr. Edison would be over an hour exhausting the air by means of a mercury air pump. He would then slowly raise the filament up to incandescent by raising the current step by step. The lamp would become brighter and brighter, and for the space of a few minutes the tension would be so great you could hear a pin drop. Most of the lamps popped out after they had burned a few minutes. Mr. Edison would carefully label the lamp, marking the material used, the amount of current consumed before the filament broke, etc.

When Mr. Edison made the announcement to the world that he had finally invented a small incandescent lamp with a thin filament of carbon in a vacuum, and that these lamps could be made and sold for 25c each, the world stood spellbound. It was a lamp that we could burn in our homes, with electricity constantly on tap, and could be turned on and off by a button or switch; it was like taking a story from the Arabian Nights. Few of us today realize what a wonderful thing this really meant to humanity. Today, in this rapid advance of scientific achievement, beyond casual wonder at the ingenuity of man, we take it all for granted, but in the pioneer days of electricity everything that came out, such as the telephone, phonograph and electric light, startled the civilized world.

In his experiments Mr. Edison finally decided on a species of Bamboo. These were carefully split and shaven down by hand and then carbonized. The little horseshoe made from this fibre was placed in a glass bulb and after the air was exhausted the bulb was sealed up. He used a small fibre of something like 200 ohms resistance hot, and used a potential of about 100 volts on the lamp. Probably almost all the scientific world at this time thought it was not possible mechanically to make these little delicate fibres of carbon. Of course, if the resistance to these carbons was not the same, the lamps would not be equally as bright, as they would take different amounts of current. Dr. Henry Stephen Morton, President of the Stevens Institute of Technology at Hoboken, read a paper before the Gas Association Convention in New York City, in which he made the broad statement that although it might be possible to make three or four lamps of this description so they would run in parallel, it would be necessary to make thousands of lamps before you could pick out a few near enough alike so they would burn together. Mr. Edison's answer to this paper was the illumination of the grounds at Menlo Park with several hundreds of these little incandescent lamps, and the following day the gas stocks all over the world fell fifty per cent. Of course, this was simply a temporary panic, and the gas companies quickly resumed their activity. The only effect electric light has had on gas has been to stimulate

[1]Electrical Engineer, Southern California Edison Company.

improvements in gas manufacture and service.

Mr. Edison not only invented this wonderful incandescent lamp, but he also invented fixtures, key sockets, safety fuse plugs and meters, and within a year or so had started in the distribution of electricity from a central station. The first commercial station of any size was the large two-wire station on Pearl street, New York City. Mr. Edison had at this time the idea of running small motors for household use, off the same circuit, and even in 1879 had built a motor (although it was entirely too large) to run an experimental sewing machine. He then predicted that the small motors would in the years to come be in common use to lighten household drudgery. Now, thirty years later, we are just beginning to introduce them for general household use. Mr. Edison picked out 100 volts as the standard; this voltage being low enough so that the shock would not seriously effect humanity, and still high enough to insure economical distribution of current in a building. To-day we are using approximately 100 volts as the standard for house lighting throughout the world. The standard base screw that was used on the bottom of the lamp he invented, is the standard to-day; the standard plug fuse that could be used only once and then thrown away, is still the standard. Mr. Edison was an enthusiastic experimenter, he was never discouraged, and took nobody's word that the thing was impossible—although "he was not from Missouri, we had to show him."

In the latter part of 1879 I was sent to Europe with several other engineers to install and operate Mr. Edison's loud-speaking, chalk telephone. It was a scientific wonder, as the sound produced by the telephone was louder even than when it entered the transmitter. I think the main reason for inventing this loud telephone was due to the fact that at that time Mr. Edison was quite deaf, and had great difficulty in hearing the telephone even when the carbon transmitter was used, but this telephone was too complicated for public use and was soon laid aside. To-day it is simply a curiosity in the museums where scientific appliances are shown.

The Edison Telephone Company opened offices on Queen Victoria street, London. The experiences of an American working in a foreign country are sometimes very amusing. I shall never forget my first experience with the idioms of the language in England. I went out to purchase a small monkey wrench and inquired of a dignified English policeman if he could direct me to a hardware store. His face was a perfect blank, and it was only after I had explained that it was a place where they sold nails and screws that he brightened up and said, "Oh, what you want is an iron monger's shop." I found the shop and after drawing a sketch of the monkey wrench I was trying to find, the proprietor of this iron monger's shop told me I should have asked for a screw spanner. We had several apprentices who went under the title of "gentlemen apprentices." They paid the sum of fifty pounds for the privilege of working with this new device, and drew no salary. We installed these loud speaking telephones in all the clubs and several of the leading mercantile houses, but they required practically daily inspection to keep them in good operating condition.

We had among our force in London the famous Bernard Shaw, although at that time he did not dream that he was to become famous. I found in a recent book an interview with Mr. Shaw, in which he gave his impressions of the introduction of Mr. Edison's telephone into England, and of his views of the men sent over from America, in the following vivid and amusing language:

"A much too ingenious invention, being nothing less than a telephone of such stentorian efficiency that it bellowed your most private communications all over the house, instead of whispering them with some sort of discretion. Whilst the Edison Telephone Company lasted it crowded the basement of a high pile of offices in Queen Victoria street with American artificers. These deluded and romantic men gave me a glimpse of the skilled proletariate of the United States. They sang obsolete sentimental songs with genuine emotion; and their language was frightful even to an Irishman. They worked with a ferocious energy which was out of all proportion to the actual results achieved. Indomitably resolved to assert their republican manhood by taking no orders from a tall hatted Englishman whose stiff politeness covered his conviction that they were relatively to himself inferior and common persons, they insisted on being slave-driven with genuine American oaths by a genuine free and equal American foreman. They utterly despised the artfully slow British workman, who did as little for his wages as he possibly could; never hurried himself; and had a deep reverence for one whose pocket could be tapped by respectful behavior. Need I add that they were contemptuously wondered at by this same British workman as a parcel of outlandish adult boys who sweated themselves for their employer's benefit instead of looking after their own interest? They adored Mr. Edison as the greatest man of all time in every possible department as the greatest man of all time of science, art and philosophy, and execrated Mr. Graham Bell, the inventor of the rival telephone, as his Satanic adversary; but each of them had (or intended to have) on the brink of completion an improvement on the telephone, usually a new transmitter. They were free-souled creatures, excellent company, sensitive, cheerful and profane; liars, braggarts, and hustlers, with an air of making slow old England, hum, which never left them even when, as often happened, they were wrestling with difficulties of their own making, or struggling in no-thoroughfares, from which they had to be retrieved like stray sheep by Englishmen without imagination enough to go wrong."

The French Edison Company started its factory in 1881, manufacturing lamp sockets, fixtures and dynamos for completely equipping electrical installations; in fact the company made everything electrical except the wire. The sockets and cut-outs were made mostly of wood, and the dynamos were the old "Anna Maria" type, with long magnets in multiple; the Z. L. and K. types predominating. They also built a few of the direct coupled Jumbos, the first bar wound machines made, the bars being insulated by paper and the ends of the bars fastened to discs to cross the end of the armatures. The screws and contacts

were gold plaited to keep from oxidizing. There was also a good-sized blower to keep the machine cool. From this French company many companies were organized in different parts of Europe.

About this time Mr. Edison invented the famous three-wire system which greatly increased the area of distribution for direct current, and which today is in common use in all the large cities of the United States.

Today Mr. Edison's name is connected with practically everything electrical and I doubt if for generations to come there will arise another man who will render as great service to humanity as he has done in teaching us how to harness one of nature's greatest forces and make it our servant.

AN IMPORTANT COMMISSION DECISION.

In deciding the controversy between the Pacific Gas & Electric Company and the Great Western Power Company, the Railroad Commission has laid down a set of principles of vital importance to every community and to every public utility corporation in California. The issue hinged upon the interpretation of that section of the newly adopted Public Utilities Act bearing upon the "certificate of public convenience and necessity." Under the terms of the act, public utilities, with few exceptions, may enter a new field or extend into a new territory only after they have been given certificates of public convenience and necessity. The Railroad Commission has power to grant or to deny these certificates.

The decision of the Commission in the Pacific Gas & Electric-Great Western Power case establishes for the first time the principles which, in a large measure, will guide it in passing upon applications of this sort. The decision was unanimous. It was written by John M. Eshleman, chairman of the board, and concurred in by Commissioners H. D. Loveland, Alex Gordon, E. O. Edgerton and Max Thelen.

After quoting that portion of the Act referring to "certificates of public convenience and necessity," the decision proceeds:

While the general intent of this provision of the act is plain, its application to a particular contingency is surrounded by much difficulty. It certainly is true that where a territory is served by a utility which has pioneered in the field, and is rendering efficient and cheap service and is fulfilling adequately the duty which, as a public utility, it owes to the public, and the territory is so generally served that it may be said to have reached the point of saturation as regards the particular commodity in which such utility deals, then certainly the design of the law is that the utility shall be protected within such field; but when any one of these conditions is lacking, the public convenience may often be served by allowing competition to come in.

It has been urged in this proceeding that where a utility occupying a field has generally served such field so that the advent of a second utility would merely serve to divide the business, then if the existing utility has the ability, if it choose to do so, to furnish such territory efficiently and at as reasonable rates as can be legitimately accorded by the utility desiring to enter the field, even though it had theretofore charged excessive rates or given inefficient service, yet sound economy would require the authority, which has the power to regulate the rates and service of such utility to require the existing utility to furnish such territory adequately and cheaply and to keep the second utility out.

Theoretically much can be said in favor of this contention, but to attempt to apply it would in practice defeat the very intent of the Public Utilities Act in all cases where utilities did not voluntarily accord to their patrons those things which are their due, or at least, would impose upon the public authorities the burden of forcing such utilities into a realization of what their proper relationship to the public is. In times past in this state efforts on the part of public authorities to force utilities to give reasonable rates and adequate service have been met with long continued litigation and if the public authorities have at hand an efficient and summary method of forcing public utilities to accord to their patrons such reasonable rates and adequate service, then, in our opinion, it is their duty to use it.

If any territory served by an existing utility is afflicted by such utility with excessive rates or inefficient service, and a second utility of the same kind desires to enter such territory and this Commission should say to the existing utility "although when you had matters your own way, you lost sight of your duty to the public, yet we will still preserve for you this territory in consideration of your future good behavior," in how many instances does any one suppose a new utility would apply to enter a territory served by an existing utility when the only effect of all its trouble and expense would be the cheapening of the rate and the improvement of the service of the existing utility? And hence if we should in the very first important contested application for a certificate of public convenience and necessity announce the rule that where the major portion of a territory is served, though inefficiently and at high rates, the result of such application will be merely to put the existing utility upon its good behavior, then we would, in effect, be saying to all the offending utilities of this state, if there be any, "you may proceed with your present methods until competition knocks at the door of your territory and only then will you be compelled to do justice" and we would be saying to every new public utility "you will knock in vain at the door of any field now served by a utility."

The result would be that old utilities would keep their territory unspurred by the fear of competition, knowing always that only when it was imminent need they prepare to do justice to their patrons, and the new utilities, having no incentive to apply for permission to go into territory more or less completely, but inefficiently served, would limit themselves to new fields within which they would soon, in turn, assume the same attitude as would be assumed by the old utilities now doing business within the state.

Rather, do we announce the rule that only until the time of threatened competition shall the existing utility be allowed to put itself in such a position with reference to its patrons, that this Commission may find that such patrons are adequately served at reasonable rates. By announcing this principle, we hope

known as the absorption system, introduced about 1850. This has seen great development in the last ten years and promises to supplant all other methods, especially in small installations. It seems to have been unearthed purposely for us in our business, and I know that the day is not far off before we will be operating an electrical refrigerator in every household. It will automatically refrigerate the icebox at low cost and eliminate the iceman.

The absorption process needs no moving power to operate it. Its construction and operation is crude and cheap, and it occupies little space. To make a long story short, it works about like this: There are two metal cylinders connected by a small tube, one of these cylinders is placed inside the ice box and the other outside. The outside cylinder contains anhydrous ammonia, the inside cylinder, nothing. The outside cylinder is heated, raising the ammonia to a high pressure, when it is forced into the cooler inside cylinder where it condenses. The heat is then discontinued on the outside cylinder, which cools off by radiation, the anhydrous ammonia within it calling back its constituent gases from the inside cylinder where intense cold takes place. Gas appliance manufacturers are now placing on the market a small absorption machine, but think of the advantage electricity has over gas in supplying the heat to the outside cylinder from within it, the same as is done by the electric percolator or flatiron. The gas refrigerator heated as it must be by an outside flame, will be cumbersome, annoying and inefficient and only act as a temporary stepping-stone to the adoption of electric refrigeration.

ELECTRICAL PUBLICATION BY BUREAU OF MINES.

The United States Bureau of Mines has just issued Technical Paper No. 19, written by H. H. Clark, the bureau's electrical engineer, on the subject, The Factor of Safety in Mine Electrical Installation. The author acknowledges the many advantages that are known to attend the use of electrical machinery in mines, but urges that the requirements of safety as well as those of efficiency be considered when installing electrical mining equipment.

The paper calls attention to the fact that whenever the service conditions are indeterminate or variable, engineers are accustomed to use factors of safety in their designs, especially in those cases where the protection of human life is a consideration. The author believes that a similar factor of safety should be used in connection with the electrical equipment of mines.

SANTA CRUZ CARNIVAL.

Perhaps the most extensive and elaborate water pageant and carnival ever attempted on the Pacific Coast has been planned by Mr. Fred Swanton, for the summer resort city of Santa Cruz, commencing Saturday, July 20th, and ending in a blaze of fireworks on Sunday, July 28th. Ever since the Casino at Santa Cruz closed last fall, Swanton has been at work on his idea, with the result that all arrangements have been completed for a truly remarkable nine-day festival at the popular watering place.

Among the hundred features which have been prepared in order that the water pageant may go down in history as a remarkable success, are the following: A yacht regatta to which all of the yacht clubs of the Pacific Coast have been invited and which will be held under the auspices of the Corinthian Yacht Club of San Francisco; a series of motor-boat races on San Lorenzo River, along which reviewing stations garlanded with flowers and flags are now in process of construction; parades of decorated floats, corresponding to those used in New Orleans at Mardi Gras time; shell and small boat races; swimming contests and nightly displays of fireworks and flambeaus.

The presence, during the festivities, of several of the largest and finest vessels in the Pacific Squadron, has been assured. In addition there will be the usual opportunities for unsurpassed surf bathing; dancing every evening in the Casino; side-trips to the Big Trees and through the wonderful canyon connecting Santa Cruz with the Big Basin country, and other features.

The large and beautiful Hotel Casa del Rey, recently completed at an expenditure of a tremendous amount of money and energy, is arranging to take care of part of the immense crowd which promises to assemble at Santa Cruz during the nine days of the water pageant. The management of the big hostelry has assured the public that there will be no advance over their regular rates, which are unusually moderate considering the fact that every room in the immense building is an outside room and is flooded with daily sunshine. The Casa del Rey will accept advanced reservations from this date until the opening of the carnival. In addition to the accommodations offered by this hotel, the Tent City at Santa Cruz is now in full bloom and there are many other, though smaller, hotels and boarding places which afford comfortable lodging for a vast host.

The Southern Pacific Company, which maintains a fast and superior service between San Francisco, Los Angeles and tributary points to Santa Cruz, is arranging to make especially low rates to the Surf City and return, for the period commencing July 20th and ending July 28th.

TWELFTH ANNUAL CONVENTION NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION, DENVER, COLORADO, July 17, 18, 19, 1912.

Headquarters and Registration Bureau at Albany Hotel.
Open and Business Sessions in Convention Hall, Albany Hotel.

JULY 16th, 1912.

Directors' Meeting, Albany Hotel, 10 A. M.
Registration Bureau at Albany Hotel opens at 5 P. M.

JULY 17th, 1912.

Open Session at Albany Hotel at 10 A. M.
Speakers on subjects of general interest to the trade.
Business Session for members only at Albany Hotel at 2 P. M.
Seeing Denver, trip for Ladies and Guests, starting from Albany Hotel at 3 P. M.
Reception and Dance in Reception Room Albany Hotel, 8 P. M.
Sons of Jove Rejuvenation, 10 P. M.

JULY 18th, 1912.

Business Session, for members only, Albany Hotel, 10 A. M.
Luncheon tendered by The Denver Electrical Club, 12:30 P. M.
Business Session, for members only, at Albany Hotel at 2 P. M.
Dinner for Ladies, Guests and Members, Albany Hotel, 8 P. M.

JULY 19th, 1912.

Trip over the Moffatt Road, leaving Albany Hotel at 8:30 A. M.
Special train leaves at 9 A. M. sharp. Lunch served on train.
Returning, arrive in Denver at 5:30 P. M.

The following are the nominations for officers for the ensuing year:

President—Ernest Freeman, Chicago, Ill.
First Vice-President—H. S. Potter, Boston, Mass.
Second Vice-President—J. C. Hatzel, New York City.
Third Vice-President—W. L. Hutchinson, Kansas City, Mo.
Treasurer—John R. Galloway, Washington, D. C.
Secretary—W. H. Morton, Utica, N. Y.
Sergeant-at-Arms—J. C. Sterns, Buffalo, N. Y.

ELECTRICAL REFRIGERATION.

BY H. N. SESSIONS.[1]

Electrical refrigeration simply means transforming electricity into cold. Electricity we know is the most potent of all natural forces. It is disguised everywhere in the form of restless elements, but we most often find its hiding place in heat. Heat can be turned into electricity and back again into heat. When a body contains much heat we may say it is warm or hot: if it contains less heat, we may say it is cooler or cold. Refrigeration is the act of cooling a body by causing the heat in it to flow to another substance in contact with it. It really means robbing one body of its heat to heat another; hence, we see that after all, refrigeration is merely a process of handling heat.

Before a refrigeration machine is set in operation, all parts of the system are at the same temperature with the surroundings, but when in operation, one section of the apparatus acquires a very negative temperature while the temperature of the remainder of the plant becomes abnormally high. It must be obvious to us all that there is a strong affinity between

H. N. Sessions

these two extremes of temperature in a plant and that much neutralization of energy takes place unless the heat can be so controlled and insulated to prevent it.

The rapid development made in electric heating elements makes it possible to confine and utilize heat only at the very point where it is needed. Heat in the form of electricity can enter and pass through cold places practically without loss; it can heat the interior of the vaporizing chamber from within without loss by outside radiation.

Natural refrigeration, the snow for example, like natural electricity, the lightning, was known from the beginning, and it may surprise us to know that even as early as the Greeks discovered artificial electricity in amber and named it therefore "electron," their eastern brothers on the plains of Arabia knew of and were making practical use of an artificial means to cool and even freeze water.

For centuries artificial means of producing electricity and refrigeration have been slowly improved. Each was a study in itself and there seemed to be nothing particular in common between these two sciences; however, in the last twenty-five years both electricity and refrigeration have taken greater strides than in all time before, and development has brought them nearer and nearer together. Let us go a little further into refrigeration before discussing its relationship with electricity.

The method employed by the ancients was evaporation; they placed shallow earthenware dishes on a bed of cornstalks or other non-heat-conducting materials where they would be subjected to a draft. Part of the water was vaporized, and in leaving the vessel carried heat with it greatly reducing the temperature of the remaining water. We know of many simple examples of this principle, such as the soldier's canteen covered with wet burlap, the Mexican porous olla, and how easy it is to freeze the hand by moistening it with ether or some volatile liquid and holding it before a fan motor.

In 1775 the application of a vacuum pump to facilitate evaporation was introduced and since then the process has been practiced with success so far as the refrigeration is concerned, but it failed commercially by reason of the great expense entailed. Next in 1834 the compression system was introduced and this is the system mostly in use today. It is a machine which compresses a volatile substance such as ammonia, or ether gas for example, and then allows it to expand again. We all know that compression raises the temperature of a substance, and expansion lowers the temperature; hence by compression of the gas in a refrigerating machine, heat is raised and escapes from the machine, and by expansion of this same gas in another part of the system, the temperature is lowered just to the extent of the heat raised and given off by compression. The same gas is compressed and expanded over and over again until much of its heat is driven off.

This process, of course, requires power, but where refrigeration machinery is used for ice making, there have been heretofore many obstacles in the way of the electric drive. It has been necessary to vary the speed of the compressors during different stages of the cooling process, and this in the past could be done more readily with the steam engine; however, today we can accomplish this nicely with either d.c. or a.c. motors. Another obstacle to the electric drive has been that water used for ice making in the can system must have all the air expelled from it by boiling it first; else it will freeze white and opaque like snow. The exhaust steam from the steam engine is turned into the water to be frozen thus accomplishing this ejection of the air from the water at little cost. However, the recently adopted plate system of ice making gives us clear transparent ice from water which may be full of air or other impurities. All we need in this case is power, and the electric motor is the best because it will furnish the force without imparting heat to the surroundings and killing the low temperature as a boiler and engine will do.

From the above improvements in the compression system, we can see that refrigeration, like everything else, is slowly becoming more dependent upon our great agent, electricity.

Now comes another system of refrigeration,

[1]Commercial Engineer Southern California Edison Co.

we shall hold out to the existing utilities an incentive which will induce them voluntarily, without being compelled by this commission or other governmental authorities, to accord to the communities of this state those rates and that service to which they are in justice entitled, and to the new utilities we shall likewise hold out the incentive that on the discovery by them of territory which is not accorded reasonable service and just rates, they may have the privilege of entering therein if they are willing to accord fair treatment to such territory.

We understand the certificate of public convenience and necessity to be in this state largely a precautionary measure. We have already dealt somewhat at length with the cases wherein we believe competition should be allowed, even though such competition will mainly serve to take patrons from the existing utility. If, however, a territory is completely served and the utility has, to the best of its ability, given fair treatment to its patrons, as already intimated, this commission will be slow to permit a competitor to come into this territory.

One of the few cases where, under such circumstances the competitor will be permitted to enter the field, will be where the competitor can adequately furnish the commodity at a rate so much less than the rate which can be accorded by the existing utility, that the interests of the public demand the commodity at the lower rate.

We are aware that this may work hardships upon small companies and we are likewise aware that the state owes a duty to the small utility which has gone into a field and furnished the inhabitants thereof the service which would otherwise have been denied them. When the advent of the new utility, under such circumstances, will serve, through legitimate competition, to impair the investment of the existing utility, the difference in rates which may be legitimately accorded by the new utility must be so considerable that the public interest clearly demands the rendition of the service at the lower rate before this Commission will be moved to permit the competitor to enter such field, provided always, as we have already said, that the existing utility, be it small or great, has been doing its best to treat its patrons fairly.

Competition does not necessarily become duplication unless the field covered by a natural monopoly is completely served.

California has just begun her development. We have no doubt that as a rule in this state the going in of a second utility will develop a considerable amount of new business, while leaving an ample field for the existing utility. Such being the case, the instances wherein this Commission will deny a certificate of public convenience and necessity by reason of the fact that another utility is already in the field will be comparatively rare. If we had as dense a population as exists in some of the eastern states and if our territory were supporting practically the limit of its population and practically all the territory of this state were covered by the plants of existing utilities, then under he rule we have already announced practically the only cases wherein a second utility would be permitted to compete would be those cases wherein the present utility was remiss in its duty to the public.

But the fact that a power line, for instance, crosses a county and in the immediate vicinity of its line is distributing electricity for power and light purposes, certainly could not lead us to conclude that the entire territory of such county was completely occupied by the existing utility. Many thousands of horsepower of hydroelectric energy are now being developed and we have no doubt that the rapidly increasing population and the expansion of enterprise within this state will develop a market which will keep pace with the increase of the supply of this commodity.

In conclusion the commission says:

In considering this entire matter, we have not lost sight of one other fact which we believe should be given consideration by us. At the time of the passage of the Public Utilities Act, various enterprises were in the process of construction and steps had been taken towards entering the field which might not have been taken had the Public Utilities Act been in effect. We might very well lay down a different rule for a new utility that now desires to begin operation and that has not invested large sums of money on the faith of its rights to do business in a competitive field. While the present undeveloped condition of California might lead us to apply slightly, if any, more strict rules to a new company than to one in existence and with its enterprise mapped out before the going into effect of this act, yet as development increases and the available market for electrical energy becomes more nearly satisfied, we believe that public policy will require us to adopt rules of increasing strictness, and when we shall have reached a development such as now exists in some of the older eastern states, as we have already said, probably any public utility of the kind for which a certificate of public convenience and necessity is required, may feel safe within its field so long as it adequately serves the public at reasonable rates and assumes that position toward its patrons which public policy demands.

A RECENT RULING OF THE KANSAS COMMISSION ON PUBLIC CONVENIENCE AND NECESSITY.

As directly opposed to the California commission ruling and hence of timely interest the following is an excerpt from a ruling on public convenience and necessity just made by the Kansas Public Service Commission:

Now on this 11th day of June, 1912, comes on to be heard the application of the Farm & Grange Telephone Company for permission to engage in the business of a public utility in and around the city of Westphalia.

The commission having heard the application, and the evidence, and being fully advised in the premises, finds that public convenience and necessity would not be promoted by permitting another telephone company to build a system in Westphalia, and the prayer of the petitioner should therefore be denied for the present.

The commission further finds that the telephone service now accorded the people of Westphalia and vicinity by the Westphalia Telephone Company is inadequate to meet the needs of the people.

It is therefore ordered that the said Westphalia Telephone Company be, and it is hereby, given thirty days from date hereof in which to place its lines in good condition, and give adequate service. If at the end of that time, adequate service is not given, the commission will consider a motion for a re hearing.

PHOTOGRAPHY IN ENGINEERING WORK.

BY M. R. LOTT.

The Dark-Rooms.

The general arrangement of the dark rooms should be conducive to speedy and efficient operation, the layout shown in Fig. 1 being suggested as fulfilling these requirements. The lightproof qualities and illumination should be carefully considered. All the walls and woodwork in the dark-rooms, with the exception of the surfaces of the work tables, should be given a finish of dull black. General illumination separate from the ruby lights should be provided. Cleanliness is vital to good work and the walls, floors and utensils should be kept scrupulously clean.

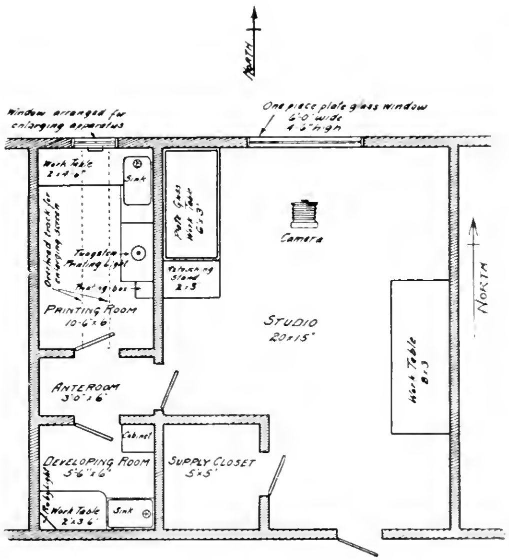


Fig. 1. General Photography Layout.

The Developing-Room.

The developing room shown in Fig. 1 has the general dimensions of 5 ft. 6 in. x 6 ft. and is equipped with a work table, sink, shelves and a cabinet for storing developer and the chemicals which are in constant use. The work table should be finished in wax and should be arranged to drain toward the sink. The ruby light may be conveniently placed in the corner, over the work table. A forty watt carbon incandescent lamp with a ruby colored globe placed inside a box of triangular horizontal cross section provided with an additional screen of red paper gives a safe working light. A ventilating hole should be made in the cover of the box containing the ruby light.

As the dark room is the proper place to mix developers, arrangement should be made for attaching a disc heater to the electric light circuit, the heater being for the water used in dissolving the chemicals.

The sink may be of the ordinary kitchen type. A short rubber hose attached to the faucet proves to be a handy accessory. Shelves placed above the sink are also convenient.

The Printing-Room.

As the printing room is to be used in the making of Bromide enlargements, its size should be larger than that of the developing room, though the general arrangement may be practically the same. Fig. 1 shows the plan of a convenient printing room and Fig. 2 gives the longitudinal section of the same.

The finish of the walls should be the same as that of the developing room.

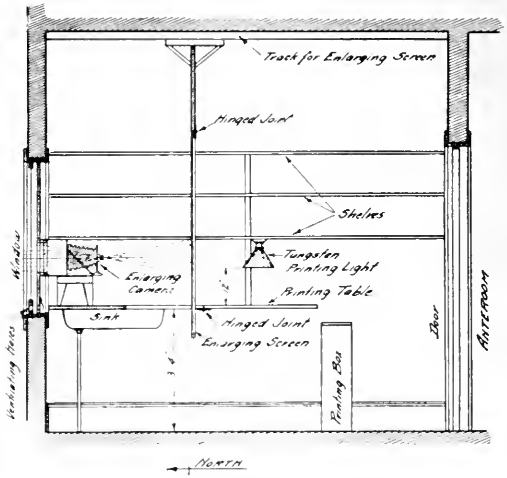


Fig. 2. Longitudinal Section of Printing Room.

An ordinary kitchen sink may be used and by use of the scheme shown in Fig. 3, this sink is easily adapted to washing prints. The device shown consists of a piece of galvanized iron pipe provided with drain holes near the top, and a large washer made of rubber packing to make a tight joint with the sink at the bottom, the whole device being clamped to the sink by means of a strip of wrought iron placed across

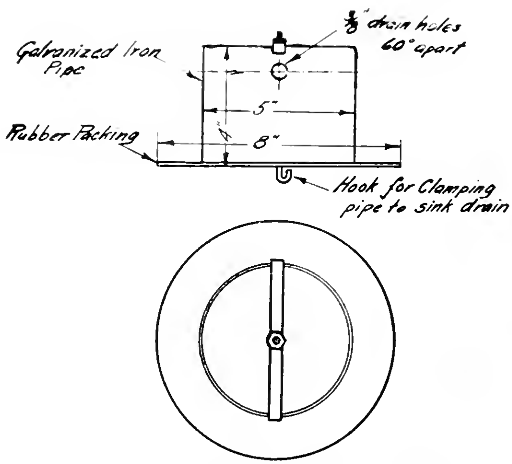


Fig. 3. Sink Overflow Arrangement for Washing Prints.

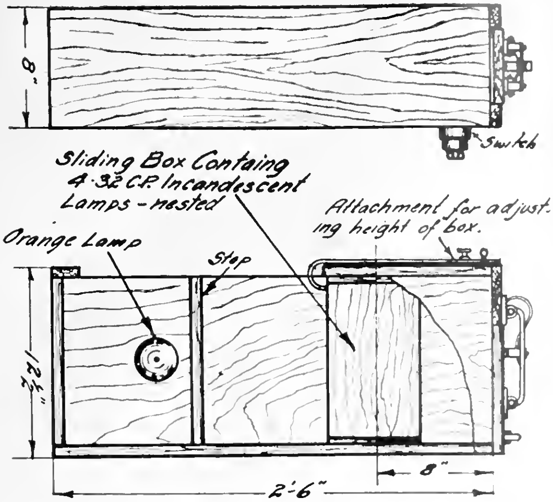


Fig. 4. Printing Box

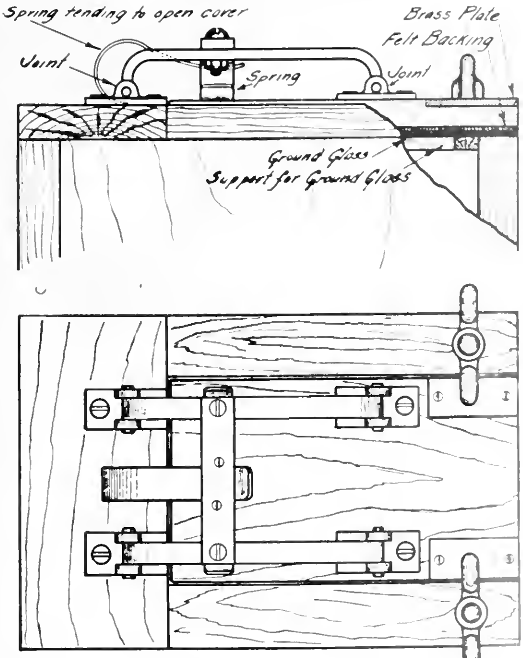


Fig. 5. Details of Cover for Printing Box

the top and a hooked bolt which fastens to the sink drain. A short piece of rubber tubing attached to the faucet is a great convenience.

Shelves placed along each side of the room furnish a place for storing printing frames, and other devices. The under side of the bottom shelf gives a very good place to attach the ruby lamps and the tungsten printing light as well. Sixty watt carbon filament lamps with ruby colored globes give a good safe light. The window of the dark room is arranged for making enlargements, its construction being indicated by Fig. 2. Ventilating holes are bored in the frame work at the bottom of the window sash. Inside the window sash a board cover excludes all of the light except where the attachment for the enlarging camera is made. Holes with a covering hood are provided at the bottom of the board cover. For enlarging, the opening left in the board cover is provided with an attachment which will accommodate the plate holder containing the negative from which the enlargement is to be made. The enlarging camera may be attached to this arrangement by means of spring clips, which are supported by a small stand resting on the work table. When not in use, the camera is removed and a ruby glass fitted in the plate holder. This makes a good safe light with which to work while carrying on printing operations.

A track along the ceiling is provided for carrying the screen holding the photographic paper when making enlargements. The screen has a hinged joint near the top so when it is not in service it may be folded up out of the way in such a manner that the free end will rest on the top of the door frame.

For printing, a 100 watt tungsten lamp, equipped with a shade and placed one foot above the printing table is good. The printing table should be hinged so that it may be folded down out of the way when enlargements are being made.

When a number of prints are to be made from negatives (5 in. x 7 in. or smaller) a great deal of time may be saved by the us of a printing box, as shown in Fig. 5. This consists of a wooden box-like shell containing a sliding arrangement which holds four 32 candle-power carbon filament lamps. This is also fitted at the top with a ground glass support for the negative, a spring cover securely fastens the printing box. The cover is so arranged that it tends to open when released. It is backed with a felt lining to insure good contact between paper and negative. A safe orange light is placed near the bottom of the box which is kept burning during the time the printing box is in service, thereby assisting greatly in the proper adjustment of paper and negative. The distance between the printing light and the negative is adjustable, a minimum distance of 8 in. being allowed. The lamp globes in the sliding box are nested together in order to obtain a more even distribution of light.

ELECTRIC SMELTING OF IRON IN CALIFORNIA.

The Noble Electric Steel Company is increasing the capacity of its electric iron smelter at Heroult, and arranging for a heavy and sustained production.

President Noble states all difficulties formerly attending the electric smelting of iron have been satisfactorily overcome, and that indications are particularly pleasing for the production of high-grade pig iron at nominal costs. A carload of the product was recently sent to a Salt Lake foundry, and was pronounced of particularly high quality. Arrangements have been made to supply large shipments to other Pacific Coast iron establishments. The company also plans the production of chrome steel and other valuable foundry products.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. Strong, President and General Manager
A. H. Halloran, V. P. and Managing Editor
Robert Sibley, Treasurer and Editor in Chief
C. L. Cory, Secretary and Special Contributor
A. M. Hunt, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

An employe of the Crocker-Wheeler Company of Ampere, N. J., was recently seized with an attack of hiccoughs which held on for several hours, until the exhausted patient was forced to ask for permission to go home. Upon leaving the shops he accidentally touched a 250-volt circuit which relieved him instantly, enabling him to return to work.

Visions of the hungry-eyed commercial man!!!

Undoubtedly the latest argument to the dainty housewife for electric power introduction into the home will continue to be for toasters, curling irons and the like but with the side-wink that it will be a lesson teacher and instant reformer for Johnnie when he comes warbling home at 4 a. m.

An Important Public Utility Decision

Strong commendation for those having in charge the administering of the enactments of the recent public utilities act has been emphatically expressed in these columns during recent months. The outspoken and manly manner in which these young men have set about to perform their high public duty is well illustrated in a recent decision, an abstract of which may be found on another page of this Journal.

The principles set forth in this decision are of vital importance.

One of the largest hydroelectric companies of central California in an effort to shut out a second large company from entering its field of activity petitioned the Railroad Commission to refuse its competitor the necessary certificate of public convenience and hence entrance into territory alleged to be already occupied. The decision is well written and speaks with the force of scholarly deliberation.

As to opening up and encouraging free competition among public utilities the decision as a whole is, however, totally at variance with the principles enunciated by decisions in eastern public utility commissions—notably New York, Wisconsin, and most recently in Kansas. To quote from the ruling in question the four points which would appear to the California Commission as necessary to shut out competition may be gleaned from their writing:

> "It certainly is true that where a territory is served by a utility which has pioneered in the field, and is rendering efficient and cheap service, and is fulfilling adequately the duty which, as a public utility, it owes to the public, and the territory is so generally served that it may be said to have reached the point of saturation * * *, then certainly the design of the law is that the utility shall be protected within such field; but when any one of these conditions is lacking, the public convenience may often be served by allowing competition to come in."

The public utilities act which went into effect on March 23d of the current year is definite and specific in giving full powers to the Commission. In Article II of this enactment full powers of passing upon the efficiency and adequacy of service, rates and extensions are given to the Commission and Section 76 gives the Commission by civil and criminal proceedings full authority to enforce its rulings with every weapon of the law.

All authorities agree, as is borne out in countless decisions of eastern public utility commissions, that utility companies must be protected against direct

competition. Such companies are operated with greatest benefit to the public as controlled monopolies. Much food for serious reflection is to be found in ruminating over the proposed method of whipping the utility corporations into line from fear of competition in violation of this great economic law. With the passing of the new act responsibilities of a higher nature than formerly entertained were assumed by the people of the state of California. The people emphatically said they want rates at fair and reasonable prices and in return the great server of the people shall receive fair play—a fair play indicative of confidence in them and a reasonable return on the actual investments at stake. And to cement this paternal feeling a Commission was empowered to wisely and fearlessly bind the partnership by dispensing fearless justice to both parties—neither the one nor the other to receive the advantage.

The ideal basis of rates is cost of service. The service should be efficient but not necessarily "cheap," as called for in the Commission decision. We maintain that cost of service based upon a reasonable return from the actually invested capital should be the sole and final basis of rate fixing. We suggest in friendly discussion that the use of the word "cheap" savors too much of the popular idea that the only reasonable service is that having a low money value.

Volume of business multiplied by the unit charge governs the minuteness to which distribution may be economically obtained. We suggest that a transmission line merely crossing a county may, on the basis of this economic law, constitute a saturated service in that county. The building across that county of a second company's line does not indicate either a cheaper reasonable rate in the future or even better service, for, do what you will, the fundamental economic law under such circumstances is violated. Better would it be for the Commission to urge extensions from the system already occupying the field and impose upon that system the necessity of their handling the cost of such extension, as wisely hinted at in the decision in question, on the basis of fundamental laws of rate making.

The question of distribution to a particular point is after all an economic engineering problem, the conditions of which in each particular case must be the determining factors, and largely these determining factors are arbitrarily fixed by the rates allowed in the particular community to be served. The Commission has been given ample authority to fix rates and to order extensions of service and even authority to demand better service in fields already occupied.

Hence, we ask, in friendly discussion, is the competitor necessary?

To us it appears that the whip of competition should be withheld as the final means of compulsion rather than the preliminary. The decision as to inadequacy of service and reasonableness of rates should be determined from facts occurring since the passage of the public utilities act and not from complaints handed down from preceding generations of owners and executives long since passed away.

The highest development of the great economic law of public utility supply demands absolute divorce from competition. But in such cases where competition is demanded either due to pre-existing circumstances or later certificates of public convenience, may the Commission, armed with every weapon of the law, say to people and competing utilities alike, boldly and freely:

> "Who misses or who wins the prize,
> Go lose or conquer as you can;
> But if you fail or if you rise,
> Be each—pray God—a man."

To you men of California—be you corporation, commission, or long-suffering people—this Journal offers its columns freely for friendly discussion of vital issues such as this. The evolution of public utility regulation can not be made in a day. We are all weary pilgrims, in search of truth. Troubles, like rats in their wanderings, encircle the globe. They spread as rapidly as a school girl's secret. To the solution of the public utilities troubles of the west, the Journal has solemnly dedicated its pages. May its comments and discussions appear to its readers with the same unbiased, sincere fervor with which they are uttered.

Outdoor Substations

The ever-increasing intensive farming in the San Joaquin Valley of California, continually urges the necessity of the frequent installation of substations. The high first cost and the wages of the attendent when a modern fire-proof substation is contemplated, operate seriously to impede the installation of electrical operation in a new and untried district. Some design, then, in which danger from fire is lessened, in which temperatures are maintained at allowable heights and in which an accident would cripple only one part or transformer, became an absolute necessity.

A number of installations of this sort constituting the so-called out-of-door substation, in which the three transformers are installed unsheltered and at least 50 ft. apart are to be found in the system of the San Joaquin Light & Power Company, a description of which appears on another page of this Journal.

It was at first thought a hood painted white and enclosing each transformer in the open air might, by means of the well-known chimney effect, continually keep cool air circulating up the outside of the transformer casing, thereby protecting it somewhat from the high summer temperature. Actual experiment showed, however, that five degrees cooler temperature can be maintained without the hoods. Those familiar with the olla or magical jar of the Mojave Desert know that in this desert, water cool as ice is acquired simply by exposing this jar, which is porous, to the hot desert breezes. While the two cases are not entirely analogous yet it is reasonable to believe that in addition to the usual cooling acquired by convection currents of air the transformer casing actually exposed to the hot breezes of the San Joaquin Valley is to some extent kept cool, like the olla, simply because the hot circulating air coming in contact with the transformer casing evaporates some of the moisture in the oil thereby taking from it about one-thousand B.t.u. of heat for every pound so evaporated.

California has ever been foremost in hydroelectric development. It is to be hoped this outdoor transformer design and installation will, as pointed out by every indication, prove entirely satisfactory.

PERSONALS.

A. J. Bowie, of the Bowie Switch Company, has returned from a tour of the Pacific Northwest.

H. T. Cory has returned to San Francisco from Augusta, Ga., after an extensive tour of the Middle West and South.

R. D. Holabird, head of the Holabird-Reynolds Company, has returned to San Francisco after visiting his Los Angeles branch house.

Uno Gronvall, a prominent engineer, who is chief of the lighthouse department of the Swedish government, is at San Francisco studying the harbor conditions.

Oscar Schlesinger, of the U. S. Lighting & Heating Company, who has just opened offices in the Armsby Building, in San Francisco, has gone East to visit the factory of his company.

Ralph L. Phelps, manager of the Safety Insulated Wire & Cable Company, has returned to San Francisco, after a tour of the Pacific Northwest, and reports business good throughout his territory.

Robert Schaal, electrical engineer for the Safety Car Heating & Lighting Company, arrived at San Francisco from the East during the past week and is visiting the office of H. C. Donnell, the Pacific Coast assistant engineer.

W. G. Gooch of New York, who is counsel for the American Telephone & Telegraph Company, recently visited this city on business connected with the company in which Henry T. Scott is interested and which has for its object the sale of bottled gas.

Professor James McLaren White, supervising engineer of the College of Engineers of the University of Illinois, spent the past week at San Francisco as one of the Commissioners sent to select a site for the Illinois building on the Panama Pacific Exposition grounds.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast department, has returned to San Francisco after attending a conference of the firm's engineers who now are making their headquarters at Los Angeles in connection with important work that is being done in Southern California.

Robert Reid and **Alfred V. Guillon**, recent graduates of the electrical engineering department at the University of California, have accepted positions in the distribution department of the Pacific Gas & Electric Company the former to be stationed at Napa, the latter in Marin county.

John F. Miller, vice-president of the Westinghouse Air Brake Company, has arrived at San Francisco from Pittsburg with his family, on a tour combining business and pleasure. He will look over the plant for assembling air brake apparatus, which was recently established near Oakland by the company.

The following heads of departments of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburg, spent the past week at San Francisco: **C. S. Cook**, manager of the railway and lighting department; **J. Brewer Griffin**, manager of the detail and supply department, and **J. C. McQuiston**, manager of publicity.

C. E. Sloan, of Sloan & Robson, engineers, is at Los Angeles, after visiting Hanford in connection with the firm's designs for a sewer system and an auxiliary fire protection system which have just been accepted by that city. **F. T. Robson,** of the above firm, has returned to San Francisco after making an automobile tour through Humboldt county.

George C. Holberton, in charge of the San Francisco office of the Pacific Gas & Electric Company, delivered an address before the members of the Rotary Club at their luncheon last Tuesday in a local cafe. He explained some of the fine points of the sale of electric current in discussing the relations of the power companies to the consumers. He showed the reasons for selling power cheaper during the daytime to street railway companies, and other large consumers, than can be done during the hours of peak load, in order to increase the load factor.

Henry A. Everett of Cleveland, who is widely known as the head of the Everett-Moore Syndicate, which controls many of the independent telephone companies and electric street railways in the cities of Ohio, has been spending a few days at San Francisco. His family and several friends make up a private car party who are touring the Pacific Coast. Mr. Everett was commissioned as an expert by the cities of Toronto and Montreal to direct the conversion of their horse-car lines into electric roads. He is president of the Northern Ohio Traction & Light Company.

TRADE NOTES.

The Westinghouse Electric & Manufacturing Company has closed a contract with the City Railway Company of Los Angeles, Cal., calling for fifty-four double equipments of No. 306 L motors and HL control.

H. G. Burd, who for some time has been connected with the Standard Underground Cable Company, as sales engineer in the New York office, has been appointed assistant to the sales manager of the Standard Underground Cable Co., of Canada, Ltd., with headquarters at Hamilton, Ont.

William H. Marsh, who for the past ten years has been connected with the Standard Underground Cable Company, of Pittsburg, Pa., in the capacity of superintendent of construction, has been appointed secretary and assistant treasurer and sales manager of the Standard Underground Cable Company, of Canada, Ltd., with headquarters at Hamilton, Ont.

The General Electric Company's San Francisco office reports the sale of electrical equipment for a dredge at Galveston, Texas, to the Standard American Dredging Company, as follows: One A.T.B., 2, 1000 kw., 3600 r.p.m., 2300 v., Curtis steam turbine, and one C.C. 2, 25 kw., 3600 r.p.m., 125 v. turbo exciter set. Also, one I 26, 750 h.p., 277 r.p.m., 2200 v., Form P., D.S. 2, induction motor. Switchboard apparatus for the above is included in the contract.

The Allis-Chalmers Company, finally, secured the contract to build for the California-Oregon Power Company two 18,500 k.v.a. turbine water wheels to be direct-connected to two General Electric, 3-phase, 2300-volt generators, and also two 300-h.p. wheels for two direct-connected exciter units. It is learned that the management of the Pelton Water Wheel Company had so much other work in their San Francisco shops that they were unwilling to attend to the above contract in the limited time specified for deliveries—five and six months.

The Pelton Water Wheel Company has secured a contract from the Cornucopia Mining Company for a water wheel for a new plant in Eastern Oregon. It is described as follows: One 1200-h.p. Pelton double-overhung impulse wheel, direct connected to a General Electric 6600-volt, engine-type, alternator. The wheel will be operated under a head of 490 feet and be controlled by a Pelton oil-pressure governor. The Pelton Company will manufacture, in its pipe shop at Harrisburg, Pa., 110 tons of 20-inch steel pressure pipe and will lay the pipe line for this plant.

GENERAL ELECTRIC SALES MEETING.

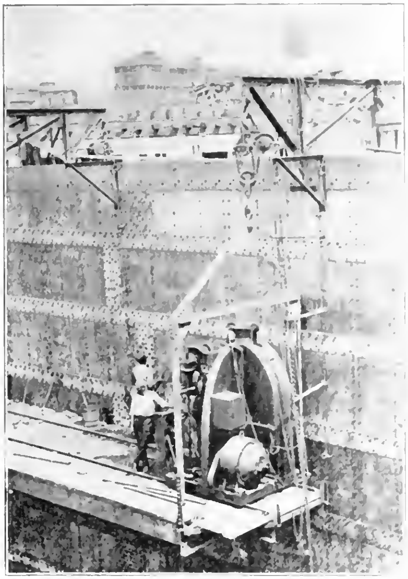
The annual convention of the Pacific Coast sales agents of the General Electric Company was held at San Francisco last week. **Dr. Thomas Addison**, Pacific Coast manager of the company, presided over the sessions at the Palace Hotel. A banquet was enjoyed at the Palace on Friday night. In addition to a good representation of the Pacific Coast agents and sales corps, a number of the Eastern managers of departments were included among the guests..

INDUSTRIAL

DRILLING 1 1/16 INCH HOLES IN ONE-INCH PLATE IN FOUR SECONDS AT THE PANAMA CANAL.

For the final riveting of the enormous lock gates at the Panama Canal, the McClintic-Marshall Construction Company of Pittsburg has installed sixteen special electrically operated machines for drilling and reaming rivet holes. Each of these machines weighs about six tons and is capable of doing the work of five of the ordinary type reamers.

The machines are designed to run on a standard gauge track and are mounted on broad adjustable scaffolds which are suspended from brackets by chains from the top of the gate, as shown in the figure.



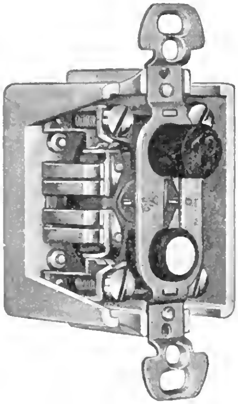
Electrically Drilling and Reaming Rivet Holes.

These machines were placed in operation in February, 1912, on the main gates of the upper lock at Gatun, and it is intended to use them on all of the gates in the three sets of locks. They were designed and built by the Foote-Burt Company of Cleveland, Ohio, especially for use on the Canal. The distinguishing features are their great capacity; a total of nine speeds, varying from very slow for heavy drilling to very high for lighter reaming; and fixed spindles arranged to suit the uniform spacing of rivet holes in the lock gates. On tests made at Gatun, one of the machines drilled 1-1/16 inch holes through 1-inch plates in four seconds, or at a rate of 15 inches per minute.

NEW CUTLER-HAMMER FLUSH SWITCH.

A flush switch without a rotating member, has been added to the line of switch specialties made by The Cutler-Hammer Mfg. Co. of Milwaukee. The simple reciprocating mechanism used in the other devices of this company has been adapted for this switch. The stroke of the buttons is short and in a straight line. The wearing parts of the mechanism are polished steel balls on brass surface, the balls giving a perfect balance of spring pressure.

Pushing the "on" button brings the contact piece forward, while pushing the "off" button breaks the contact with a sharp snap. The contact piece breaks the circuit at four points on each side which reduces arcing to a minimum and also provides for a large overload capacity. All steel

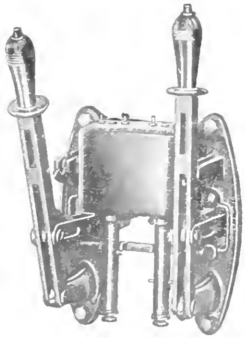


New CutlerHammer Flush Switch.

parts are copper-plated to prevent rusting and the mounting lugs will fit all outlet boxes. The rating is 10 amperes 250 volts, and the switch has the approval of the Underwriters' Laboratories and bears their label. The mechanism is enclosed in a casing made of the new molded insulating material developed in the ceramic laboratory of the Cutler-Hammer company. This material is claimed to have all the good characteristics of porcelain and none of the defects. It is tough, can be accurately molded and insures permanent alignment of parts. The same casing is used for single pole, double pole and three-way switches. Flush plates are made in standard finishes and all universal plates are applicable.

NEW OIL SWITCH.

A new oil switch known as type F, form K-5, which has lately been introduced by the General Electric Company for moderate rupturing capacities and voltages up to 7500, con-



Double-throw Automatic K-5 Oil Break Switch With Two Coils.

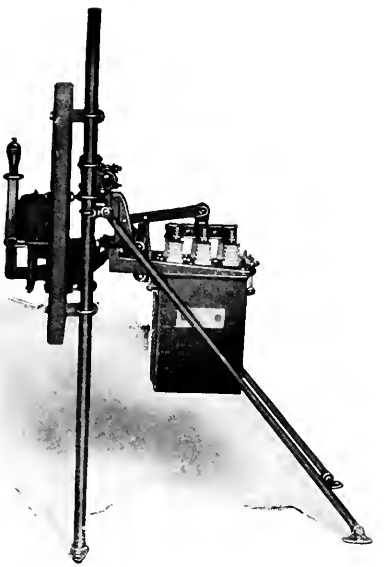
tains every feature necessary for reliability and long continued successful operation. The switches are made non-automatic and automatic, hand and solenoid operated, and for

mounting on switchboard panel, panel pipes, pipe framework, flat surfaces or in cells, and in the following capacities.

600 volts—300, 500 amps., double, triple and 4-pole, single and double throw.
600 volts—800 amps., double, triple and 4-pole, single and double throw.
4500 volts—200 amps., double, triple and 4-pole, single and double throw.
7500 volts—300, 500 amps., single, double, triple and 4-pole, single and double throw.

Automatic tripping on predetermined abnormal conditions is accomplished by current transformers and relays for all voltages, or by series trip coils on the switches themselves for potentials up to 2500 volts.

The double-throw switches consist of two single-throw units with a common frame and oil vessel. The operating levers are equipped with a single mechanical lock so arranged that one set of contacts only can be closed at one time.



Automatic Oil Break Switch Mounted on Pipe Supports

These switches occupy small space, are substantially constructed and receive before shipment a high potential test depending on the rating, but in no case less than three times the normal voltage of the circuit on which they are to be used.

The insulating bushings are of one piece removable porcelain, and the contacts are of the standard G. E. sliding wedge type.

NEW CATALOGS.

The General Electric Company recently issued an attractive Bulletin, No. 4938, devoted to its Type H. Transformers. This bulletin supersedes the previous bulletin on the same subject.

Bulletin No. 4949, just issued by the General Electric Company, is devoted to Direct Current Portable Instruments —Type DP-2, which are designed for laboratory and general testing purposes. This line of instruments includes ammeters, voltmeters, mil-ammeters and milli-voltmeters. The publication supersedes the company's previous one on this subject.

The Puget Sound Supplement of the Public Service Journal of Seattle, from the printers' point of view, is a work of art as a descriptive and illustrated article of the Stone & Webster system of water powers, electric lighting and railways of the Puget Sound. It was prepared as a souvenir for the members of the N. E. L. A. at their convention in Seattle.

The Mahoney Electric Company of St. Louis is distributing its new catalogue on high efficiency transformers. The booklet is handsomely and appropirately illustrated. The data on testing transformers is so appropriately set forth, the transformer engineer will find a desk copy most useful.

The second number of Edison Current Topics published by the Southern California Edison Company as their official house organ has been received. The leading article by James A. Lighthipe of the "Early Days of Edison," intensely interesting. Other articles by H. N. Sessions, "Electrical Refrigeration," and J. C. Haver, "Uses of the Little Red Book," completes the issue.

The Wagner Electric Manufacturing Company of St. Louis are distributing a very handsome half-yearly calendar and a novel little booklet entitled "See the Comma." The booklet is unique and describes in detail the great importance of the seemingly otherwise unimportant punctuation, the little comma. Published by the Ray D. Lillibridge, Inc., 111 Broadway, N. Y.

An attractive publication consisting of 487 pages, handsomely bound, has just been published by the Ohio Brass Company of Mansfield, Ohio. The book deals with electric railway and mine haulage equipment. Overhead material, rail bonds and car equipment specialties are the principal features. O-B-111 Tension Insulators are also detailed together with technical data on rail resistance.

Descriptive Leaflet 2496, issued by the Westinghouse Electric & Manufacturing Company, describes their out-door type, oil insulated self-cooling transformers. These transformers are of the same construction as those built for indoor service with the additional features necessary for installation outdoors. The leaflet describes the details of construction and shows several views of outdoor installations.

BOOK REVIEWS.

Testing, Fault Localization and General Hints for Wiremen. By J. Wright; size 4¼x6½ in.; 85 pages; 19 illustrations; cloth binding. Published by D. Van Nostrand Company of New York and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price Fifty Cents.

Theory is little dealt with in this booklet. It contains a thoroughly practical exposition of sixty-four simple wrinkles or hints on locating trouble in wiring layouts. These may be performed without the aid of complex or expensive apparatus. The book will undoubtedly find a welcome place among with the many other useful books dear to the heart of the wireman.

Wiring Calculations for Electric Light and Power Installations. By G. W. Lummis Paterson; size 5x7½ in.; 96 pages; replete with tables and diagrams; cloth binding. Published by Scott, Greenwood & Son, and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $2.00.

This booklet is a condensed collection of ready formulae on the subject of wiring calculators. It is divided into fourteen sections, each dealing with distinct branches of the art. Systems of electrical distribution together with direct current calculations for direct current motors, dynamos are discussed in the first five sections. Alternating current distribution for motors and generators occupy the next five sections. Insulation resistance tables and other relevant data complete the volume. The terseness with which each factor is handled is perhaps the strong feature of the booklet. No theoretical deductions are attempted. The book will be found useful as a practical handbook for the use of architects, engineers, mining engineers and electricians, wiring contractors and wiremen.

NEWS NOTES

INCORPORATIONS.

VANCOUVER, WASH.—Articles of incorporation of the Vancouver Gas Company, with $300,000 capital stock, have been filed. The incorporators are H. E. Haughun, C. R. Young of Portland, and J. P. Stapleton of Vancouver. The local plant of the Washington-Oregon corporation will be taken over and enlarged.

ILLUMINATION.

HUNTINGTON BEACH, CAL.—Henry Leukfeld has made application for a franchise to operate and establish a gas plant.

RICHLAND, WASH.—The Pacific Power & Light Company's substation at this place was destroyed by fire recently, causing a loss of $3500.

TWIN FALLS, IDAHO.—As now contemplated, the greater portion of the business section of the city will be included in the cluster light district.

ARTESIA, N. M.—The Artesia Light & Power Company has sold its entire equipment to John C. Keys, of Oklahoma City. The new owner will install more machinery and rebuild the plant.

BEND, ORE.—The Bend Water, Light & Power Company announces that it will soon start erection of a $10,000 electrical power plant, the work to be done on the unit plan. The completed plant will cost $80,000.

SAN FRANCISCO, CAL.—Permission has been granted the Great Western Power Company to extend its lines and sell electric power to the inhabitants of Sonoma, Napa and Solano counties, over the protest of the Pacific Gas & Electric Company.

CHICO, CAL.—It is reported here that valuable water rights on Deer Creek owned by the Murphy Brothers have been sold to a group of San Francisco capitalists for $75,000. It is said that the water will be used for a large light and power system. The rights to Deer Creek water have been in litigation for many years and the defense has cost the owners over $10,000. Just after the title was quieted and rights established, they were sold to the new company.

SAN FRANCISCO, CAL.—The gas and electricity rate ordinance, providing for gas at 75c and 1½c reduction a [illegible] hour in electricity, was passed by the Supervisors. John A. Britton of the Pacific Gas & Electric Company, and Supervisor Koshland debated the ordinance, Britton claiming the 75c rate confiscatory and criticising Koshland's figures. He hinted at litigation after appealing to the board to allow a higher rate.

PORTLAND, ORE.—Work will be started immediately on the big pipe line which will connect the new $3,000,000 gas plant of the Portland Gas & Coke Company at Linnton with the distributing tank at the foot of Glisan street. According to the announcement made by Guy Talbot, president of the company. The high pressure main will be six miles long and 16 inches in diameter; cost estimated at $100,000. The company will expend about $600,000 in addition during the next six months on the first unit of the gas plant at Linnton.

TELEPHONE AND TELEGRAPH.

PECOS, TEX.—Work has started on new lines and improvements of old ones of the Tri-State Telephone Company.

LEWISTON, IDAHO.—It is announced that the Inland Telephone & Telegraph Company will construct lines between Spokane and this place.

COLVILLE, WASH.—The Farmer Telephone Company is arranging to build a line from this place to the Little Pend Oreille lake, 25 miles east from here.

WEST VANCOUVER, B. C.—Steps have been taken to secure telephone service for this community, the B. C. Telephone Company agreeing to put it in on securing a certain number of subscribers.

NEZPERCE, IDAHO—The Nezperce Co-operative Telephone Company plans extensive improvements to its lines this summer. A line will be constructed from Lewiston to this place and Grangeville. The improvements will cost about $10,000.

FRESNO, CAL.—Telegraph rate reduction, ranging from 20 to 40 per cent out of Fresno have been announced by the Western Union Telegraph Company. These new rates become effective on July 1. The present rate to San Francisco is 40c and the new rate will be 30c or a reduction of 25 per cent. This rate applies to regular ten-word day messages, the rate on these being used by the telegraph companies as the basis for other rates.

SAN FRANCISCO, CAL.—At the Railroad Commission's hearing of the application of the Tehama County and Glenn County telephone companies for an order to compel the Pacific Telephone & Telegraph Company to enter into an interchange of switching arrangement with the former, the right of the Commission to make such an order was attacked by Hunt Chipley, the attorney appearing for the Pacific. The latter company is fighting the proposed interchange of switches on the ground that the public service does not require it, and Chipley, in attacking the right of the Commission under the public utilities law to exercise jurisdiction over the telephone companies in this case, intimated that the Supreme Court may be asked to rule upon the question.

TRANSMISSION.

BEND, ORE.—It is announced by the Bend Water, Light & Power Company that a $40,000 electrical power plant will be erected, work to start at once.

MARSHFIELD, ORE.—M. J. Anderson, of Grants Pass, and others are promoting a project to develop a water power project in Coos County, Ore., at a cost of $1,000,000.

SANTA BARBARA, CAL.—The Coalinga Water & Electric Company has asked for a franchise for use of roads in erecting poles and wires, etc., for distribution of electric power.

NELSON, B. C.—The directors of the West Kootenay Power & Light Company have authorized L. A. Campbell to extend the No. 2 plant at Bonnington Falls, in anticipation of the electrification of the C. P. R. from Castlegar to Rossland.

COALINGA, CAL.—An engineering crew in the employ of the San Joaquin Light & Power Company is now at work in the vicinity of Coalinga running a line for the proposed electric road from Fresno to the Santa Maria oil fields. It is the plan of the company to run a 60,000 volt aluminum power line via Kings City, San Lucas, Paso Robles, San Luis Obispo. The power will ultimately be used in the oil fields in development work. This surveying expedition is the first tangible work that has been done since the purchase by the power company of the several coast power lines, by Manager Wishon, of the local power company, and it is said to be the intention to connect this valley as soon as possible with the coast lines and ultimately the southern oil fields.

LINDSAY, CAL.—Assailing the methods of capitalization, the rates and the service of the Mt. Whitney Power Company, the Tulare County Power Company has filed its answer to a complaint filed by the former concern. The case

will be heard by the Railroad Commission when it meets in Porterville June 27. When the Tulare company started operations a few weeks before the new public service corporation laws went into effect, the Mt. Whitney Company gave notice that it would file charges as soon as the railroad commission was given the power to act. The charges were filed soon after the commission assumed its new duties.

TRANSPORTATION.

HOCKINSON, WASH.—The people of this place are raising a $15,000 bonus in order to secure an electric line.

VENICE, CAL. Plans for a tunnel for street cars along Trolley Way from Center street to Marine, are to be presented to the City Council. Cost, $250,000.

EL PASO, TEX.—A new addition to El Paso will soon be opened and the street car line will be extended to that section by the time the addition is opened.

SPOKANE, WASH.—A firm of Paris bankers, through their Tacoma connection, has voted $2,000,000 for a 30-mile electric railroad between Clealum and Salmon.

KLAMATH FALLS, ORE.—Major C. E. Worden, a local capitalist, and others are considering the advisability of constructing an electric road between this place and Bonanza.

TWIN FALLS, IDAHO.—H. L. Hollister, one of the promoters of the electric railway in this section, announces that the high bridge will be built across the Snake River at Shoshone falls.

HOCKINSON, WASH. The people of this city are ready to raise a bonus of $12,000 for the Washington-Oregon Corporation, if the concern will extend its electric line from Sifton to this place.

SALEM, ORE. The survey for the proposed line of the Portland, Eugene & Eastern Railway from here to Silverton has been completed by the Welch interests, and it is said the construction will be started before long.

SANTA BARBARA, CAL.—Application has been made by Geo. A. Cochran and Geo. A. Batchelder for a franchise to construct an electric street railway. Sealed bids for sale of said franchise will be received up to July 18.

RIVERSIDE, CAL. Announcement has been made that right-of-way difficulties with respect to extension of Riverside-Bloomington trolley line of Riverside have been cleared up and single track may be constructed at any time.

RIVERSIDE, CAL. It has been officially announced by Manager W. W. Poole of the Riverside Portland Cement Company which owns the city railroad between Riverside and Bloomington, that the road will be extended to Rialto. Construction will begin within three or four months.

SEATTLE, WASH.—Mayor Geo. F. Cotterill sent a message to the City Council recommending that the Council offer to the Puget Sound Traction, Light & Power Company franchises for needed extensions of car lines, and urges that if the company refuses to accept the franchises the city offer them for sale, and, if that plan fails, that the city build branches from the municipal street railway which the city has undertaken to construct. The railway company refuses to accept extensions unless the franchises are merged with those of the original lines.

SAN FRANCISCO, CAL.—At a recent meeting of the Supervisors a resolution providing for $247,000 out of the Geary street railway construction fund for the erection of a car house and incidentals was finally passed in spite of the contention of Supervisor McLeran that the plans called for a structure far more expensive than necessary, and that a suitable station could be erected for $150,000. Supervisor McLeran said that $60,000 to $75,000 could be saved by advertising for new bids and getting a building equally as serviceable but without unnecessary features. His proposal was objected to on the ground of delay.

OAKLAND, CAL.—The Southern Pacific Company has purchased the Dalton Iron Works property in West Oakland at the east end of the Oakland mole, lying between the company's tracks running to the Sixteenth street station and the water's edge. It is a small area, but sufficient in size to enable the company to straighten its tracks between Sixteenth street station and the east end of the mole, and thus get rid of the curve at the latter place. This is the sole object of the company in making the deal, and it is one that has been in contemplation ever since the Southern Pacific adjusted its waterfront troubles with the city of Oakland and decided to electrify its transbay ferry lines.

WATERWORKS.

SAN PEDRO, CAL.—The plan of serving San Pedro with adequate water supply will be carried out under an assessment plan.

PILOT ROCK, ORE. The $12,000 bond issue for which a special election was held for the purpose of establishing a system of waterworks for Pilot Rock carried.

RIVERSIDE, CAL. The city has purchased a quarter section of water bearing land in San Bernardino valley for the purpose of supplying domestic water to the city. Cost, $31,500.

FULLERTON, CAL.—The engineering firm of Sloan & Robson of San Francisco has filed with the City Trustees a plan for a municipal water system, recommending bonding the city for $75,000.

MILWAUKIE, ORE. Petitions are in circulation here asking the City Council to call a special election on August 24th to vote on a $10,000 bond issue with which to construct a municipal water plant and secure Bull Run water.

BELLINGHAM, WASH.—The Water Board will proceed at once to construct the new intake and new main from Lake Whatcom to the city. The total amount involved in the construction of the new supply system will aggregate $100,000 and will require two years to install.

OAKLAND, CAL.—Authority to issue a note in the sum of $71,000 and to pledge therefor as collateral security bonds to the amount of $100,000 has been requested by the Peoples Water Company. The note is to carry 6 per cent and to be placed with the Central National Bank of Oakland to take up other notes.

TULARE, CAL.—An entire new waterworks system, including wells, plant and pipe lines, is the program of R. Linder and his associates on the east side of the city. The plant will cost about $25,000. The business section of the town will be particularly cared for. It is the purpose to run two main lines of pipe down Tulare and Kern streets, 12-inch mains being used.

SAN FRANCISCO, CAL.—The application of the Noble Jones Company for permission to install a pump on the Relief Home tract for the purpose of pumping water from Lake Honda to supply certain residents who cannot be reached by the Spring Valley system may be granted, but City Attorney Long suggests as a condition that the plant be given to the city or sold thereto for a nominal figure and thereafter operated by city employes.

SAN FRANCISCO, CAL.—The Supervisors have adopted the majority report of the water rates committee, signed by Supervisors Caglieri and Mauzy, and rejected the minority report, signed by Supervisor Andrew J. Gallagher. The vote stood 16 to 2. The majority report made no change in the existing rate, while Gallagher's report provided for a 4% reduction. The majority report avoided reference to the value of the Spring Valley properties, and Supervisor Caglieri said that this had been done, and the rates left undisturbed in order to preserve the statu quo of the negotiations for the purchase by the city of the Spring Valley properties. Gallagher's report provided for a 5-per-cent return to the company on a valuation of $26,000,000.

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